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REPORT

OF THE

SPECIAL MILK BOARD

OF THE

MASSACHUSETTS STATE DEPARTMENT OF HEALTH.

SUBMITTED TO THE COMMISSIONER OF HEALTH AND PUBLIC HEALTH COUNCIL DECEMBER 29, 1915.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
32 DERNE STREET.
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The Commonwealth of Massachusetts.

State Department of Health, Boston, Dec. 29, 1915.

To the Commissioner of Health and Public Health Council.

Gentlemen: — The Special Board of this Department appointed to investigate the status of milk production, distribution and inspection, and the relation thereof to the public health of this Commonwealth, by an order of the Commissioner of Health of March 29, 1915, has the honor to present herewith the accompanying report.

Respectfully submitted,

EUGENE R. KELLEY, *Chairman,*
JOSEPH E. LAMOUREUX,
HERMANN C. LYTHGOE,
EDWARD H. WILLIAMS, *Recorder,*
Members of the Board.

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PREFACE.

The writer became Commissioner of Health in November, 1914, and within a week he was importuned by several factors in the milk problem to take sides and give testimony for or against certain proposed legislation. The milk problem in Massachusetts had agitated the people for years, and had degenerated into an acrimonious controversy which made it difficult to separate easily real facts from mere assertions.

Milk problems exist everywhere, and the subject was not new to me as a health officer, but I felt that conditions in Massachusetts were different from other States, and that it would be unwise and unfair to apply general knowledge of a problem without a careful study of local conditions and their bearing on the problem. I felt that I had a right to proceed one year at least under existing law, and to utilize that time in informing myself as to the dairy industry in Massachusetts.

After a year's study, a fair impartial report with recommendations could be made from facts collected by an unbiased board. Accordingly, I appointed a Board to secure the facts in the dairy industry in Massachusetts, with instructions to extend their investigations to adjoining States and the Province of Quebec. I knew that without a special appropriation this could be done by this Department, but that it would involve much overtime work and considerable self-sacrifice on the part of the Board. The personnel of the Board was as follows: —

Dr. Eugene R. Kelley, Director of the Division of Communicable Diseases, formerly Commissioner of Health of the State of Washington, and a sanitarian of wide experience.

Mr. Hermann C. Lythgoe, Director of the Division of Food and Drugs, in charge of both the inspection and laboratory work of the Department in connection with milk, an analyst and chemist with a most thorough knowledge of all phases of the milk problem.

Mr. Edward H. Williams, a practical farmer and dairyman, an assistant in the Division of Sanitary Engineering of the Department, who was

selected because of his knowledge of farming conditions in the State, and especially with those conditions related to or dependent upon the milk industry.

As a representative of the Public Health Council, Dr. J. E. Lamoureux was appointed, a practicing physician of high standing, an excellent sanitarian, and the possessor of an analytical and judicial mind.

These gentlemen worked overtime, Sundays and holidays, and sacrificed vacations and other privileges, in order to carry on the work, but returned with all the available data touching our milk problem. With such a committee I feel sure not only that we have the facts, but that they are presented fairly without bias, and with only one object, viz.: to furnish a solution for the milk problem and to take it out of politics and out of controversy for all time.

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REPORT OF SPECIAL MILK BOARD OF THE MASSACHUSETTS STATE DEPARTMENT OF HEALTH.

INTRODUCTION.

The special Milk Board of the State Health Department was appointed by the State Commissioner of Health on March 29, 1915. It was charged with the duty of collecting all available facts relative to the milk problem of this Commonwealth for the guidance of the Commissioner and Public Health Council in drafting legislation to be submitted to the General Court if it should appear from the results of such investigation that new legislation was desirable.

Originally it was intended to confine this investigation to the public health aspects of milk production and distribution. Because of the closely interwoven connection between the economic and sanitary features of the milk problem your Board soon found that such a procedure was impossible, and we have, therefore, endeavored to cover the entire problem in a comprehensive manner.

The report is seriously incomplete from one important standpoint, — the total number of producing dairies personally visited by members of your Board. We estimate that in all we have seen possibly 2 per cent. of the producing farms supplying milk to Massachusetts consumers. As far as possible we have endeavored to select typical sections, and feel that in reality we have by this procedure obtained a much truer picture of average dairy conditions than if we had concentrated our visits in a smaller area and possibly visited a considerably higher percentage of the total producing dairies.

The report has become voluminous under our hands to a degree neither anticipated nor desired, but the entire problem presents so many ramifications that we felt we could not in

justice to the question omit any of the included subject-matter. In fact, many bulky sections of the report are in reality very condensed abstracts of the total data consulted.

Throughout the progress of the report your Board has been indebted to the courteous co-operation of many officials and private citizens. A partial list of these persons is given in Appendix K, and we will not attempt to enumerate them all here.

Special mention should be made, however, of the assistance given by the personnel of the Food and Drug Division of the State Department of Health, including both inspectors, analysts and clerical force. To them we owe the collection of data from local boards of health.

Two of the State district health officers, Dr. Lewis Fish and Dr. John S. Hitchcock, have in effect served as members of the Board. Several sections of the report have been contributed by them, and they have, in addition, carried out painstaking investigations into the general literature of milk and the epidemiological records of this Department. Other district health officers, notably Dr. Jones, have assisted your Board in carrying out dairy inspections.

To many city and town health officials within the Commonwealth, as well as to epidemiological authorities of other States, and of the Federal Public Health Service, we are deeply indebted for valuable information, suggestions and criticisms.

Special acknowledgment is due the following for careful criticism of various finished sections of the report: —

Dr. Charles V. Chapin, Superintendent of Health of Providence, R. I.

Dr. Mark W. Richardson, Former Secretary, Massachusetts State Board of Health.

Dr. Thomas B. Shea, Director, Division of Communicable Diseases, Boston City Health Department.

Dr. A. J. Chesley, Director, Division of Preventable Diseases, Minnesota State Board of Health.

All of these gentlemen critically reviewed Part V. of the report as to authenticity, fairness and reasonableness of the epidemiological deductions contained therein.

In a similar manner, special acknowledgment is due the following gentlemen: —

Hon. Wilfrid Wheeler, Secretary, State Board of Agriculture.
Mr. J. C. Orcutt, Assistant Secretary, Boston Chamber of Commerce.
Mr. P. M. Harwood, Agent of the State Dairy Bureau.
Hon. Chas. M. Gardner, Member of State Dairy Bureau.
Hon. William D. T. Trefry, State Tax Commissioner.

These gentlemen all contributed many facts and statistics relative to present and past production of milk.

ABSTRACT OF REPORT OF MILK BOARD.

The progress of this investigation revealed such a mass of facts and opinions bearing upon the present milk problem of Massachusetts that the inclusion of simply the most pertinent material made this report voluminous to an extent not anticipated. We have therefore deemed it wise, for the benefit of those who do not care to go into the detail of the subject, to prepare a brief abstract of the report for inclusion at this point.

The report is divided into conclusions, the main body of the report and appendices. The conclusions, which immediately follow this abstract, cannot be further summarized. The report proper is divided into seven parts.

PART I.

Section A.

In this section it is first pointed out that there has been friction between the producers, middlemen and transportation interests for at least twenty years. In addition to this source of irritation such things as overlapping laws, imposing practically the same powers and duties upon the State Boards of Health and Agriculture and local boards of health, overlapping and at times contradictory systems of dairy inspections by State and local health officials, extreme statements from all parties concerned as to the relative weight of different sanitary and economic aspects of the problem, have all contributed to the

development of the bitter controversial spirit that has been so widely manifested relative to the entire subject of production and sanitary supervision of milk in the Commonwealth during the past six years.

SECTION B.

Three special investigations, two legislative and one non-official (that of the Boston Chamber of Commerce), have added materially to the information available upon the subject, but cannot be said to have produced any definite results except the introduction of much proposed legislation into the General Court.

SECTION C.

The laws proposed for the solution of the milk problem of the Commonwealth are in general agreement in providing for the abolition of certain features of the present system of local control and the substitution of a central State inspection board with plenary powers. The controversies have all arisen over the manner in which such central board shall be appointed and controlled.

SECTION D.

It is not possible to summarize this section any further.

PART II.

In this part an attempt has been made to gather authoritative statements from various persons and interests concerned in the milk question. In general, these may be said to fall into three groups.

Group A. — Dairy and agricultural interests, comprising the State Grange, the State Board of Agriculture, the State Department of Animal Industry and the cattle breeders' associations.

Group B. — Those concerned in the business aspects of the question, viz., the milk dealers and the Boston Chamber of Commerce.

Group C. — Those interested in milk from the health standpoint, viz., the Milk Consumers' League, the Boston Department of Health and the Milk and Baby Hygiene Associations.

The general contention of Group A is that agitation and attempted legislation have had only detrimental effect on the

milk industry. Natural economic conditions, such as increase in land values, increase in transportation facilities, and more remunerative returns from other lines of agriculture have tended to drive milk production out of the State. In addition to this there is a general feeling that the attitude and statements of the so-called clean milk advocates has had a positive detrimental influence on the milk business, and has hastened the operation of these economic conditions. This group offers no remedial suggestions. The cattle breeders' associations, with the exception of the Holstein Breeders Association, in answer to a direct question submitted by your Board, believe that the price of milk should be governed by the fat content. The Grange believes that the farmers can and will produce a better article if they receive a better price.

The general contention of Group B is that the present system of distribution of milk cannot be greatly improved upon, but that the competition between retail dealers is disastrous to the financial aspects of the business, and the lack of a standardized or graded product does not tend to improve the situation. Some of this group seem to be of the opinion that official inspection should be centralized, and should be administered preferably by the State Department of Health.

In some respects the members of Group C are in accord with some of the contentions of Group B. The Health Department of the city of Boston believes that the city is being very unjustly practically forced to carry nearly all the expense incidental to milk inspection for most of the other cities and towns comprising greater Boston, and for this reason are strongly in favor of this duty being transferred to some State authority. The Massachusetts Milk Consumers' League, to use their own words, state: "The Association has never taken any arbitrary position as to the form of the bill, only insisting on the central principle that the State Department of Health should have legal power on its own initiative in places where milk is produced or handled, to insist upon reasonable cleanliness."

PART III.

Section A.

As this section is itself merely a summary of the conditions noted in the various trips of inspection made by the members of the Milk Board, it is difficult to emphasize its findings any further, but the general impression received was, although many individual and geographical exceptions to the rule were found, that producing dairies in Massachusetts were, on the whole, in very satisfactory sanitary condition, which impression is substantiated by the records of routine dairy inspections made by the State Department of Health. Typical dairies in Maine, New Hampshire, Vermont and Quebec supplying Massachusetts markets are, on the whole, somewhat below the sanitary standards of Massachusetts dairies.

Section B.

This section is a portion of the summary of replies received to a questionnaire submitted to contractors. It deals with the phases of production and of distribution of their milk supply and gives a summary of their methods of dairy inspection.

Section C.

This section deals with the production of milk in Massachusetts and neighboring States and the province of Quebec, and its increase, decrease and geographical fluctuations. Milk production in Massachusetts has steadily decreased while the population has increased. In this section the following points are discussed: variation in number of milch cattle kept in Massachusetts from 1890 to date, supplemented by evidence of freight statistics of the milk brought into greater Boston; effects of the increasing cost of producing milk in Massachusetts, and its comparison with the cost of milk production in other States and Quebec; the relative importance of dairying to diversified farming; the fact that beside the use of milk raw and for cooking purposes the steadily increasing consumption of cream, butter, cheese and ice cream accounts for a large proportion of the total milk consumed; the use of the by-products of milk, particularly of casein in the arts and sciences,

and the fact that this is a relatively unappreciated but important use of cow's milk; causes assigned by various interested parties for the decrease in milk production, the principal ones alleged being oppressive activities of the State and local boards of health in carrying out dairy inspection, the exaggerated newspaper publicity relative to milk epidemics and alleged epidemics, constant legislative agitation, the increasing use of evaporated, powdered and condensed milks brought in from long distances, lower prices offered to the producer, the development of more remunerative and less laborious forms of agriculture, together with increasing scarcity of farm labor; several pages are devoted to the actual cost of keeping cows and producing milk, according to best statistics available; the average amount of milk production per cow in Massachusetts and neighboring States; salient points obtained by interviews with agents of condensed, powdered and evaporated milk companies.

This section closes with general comments on milk production and the importance of producing more milk and the value to the Commonwealth of the dairy industry.

Section D.

In this section the influence of heat upon milk is discussed. The process of commercial pasteurization as carried out in this State is without apparent influence upon the chemical composition of milk. Experiments made in the commercial pasteurizing plants show that the process as applied is very efficient in lowering the bacterial content, but owing to possible reinfection the health authorities should control the operation of these plants.

PART IV.

Section A.

In this section is given a summary of the activities of the various bodies engaged in the official supervision of Massachusetts milk, and a digest of the laws under which they work. This work is carried on by local boards of health, the State Department of Health, the Dairy Bureau of the State Board of Agriculture, the State Department of Animal Industry, and the United States Department of Agriculture. Local boards

of health are given authority to grant licenses, inspect dairies, take samples for analysis, and to make and enforce rules and regulations. In general they have unlimited powers to adequately supervise and control the milk supply of their respective cities or towns. The State Department of Health and the Dairy Bureau have power to collect samples and to enforce the laws relative to the adulteration of milk. The State Department of Animal Industry exercises a certain amount of control over the health of cattle by an annual inspection made by the local inspector of animals.

Section B.

A special study has been made of the operation of local milk inspection from which it has been ascertained that about 20 per cent. of the total population received no protection relative to milk from their local boards of health. The balance received some protection, but only 43 per cent. are adequately protected. If Boston is excluded from the list, 25 per cent. of the balance of the population receive no protection, and only 28 per cent. are adequately protected from possible dangers arising from the milk supply.

Section C.

In this section the present system of dairy inspection is discussed in relation to its sanitary value. Although in many instances too much importance has been attached to the condition of the dairy and too little to the condition of the milk, the dairy inspection as carried out in the past has resulted in an improvement in our milk supply.

PART V.

Section A.

It is not possible to summarize this section any further.

Section B.

A number of the human communicable diseases are transmitted through milk. Those of the most importance in Massa-

chusetts are tuberculosis, diphtheria, scarlet fever, septic sore throat and typhoid fever.

In tuberculosis the milk may be infected by the cow producing it or by the human beings who handle it.

In the other four diseases mentioned, except possibly in the case of scarlet fever, the infection does not originate in the cow; the source is in the human handlers.

The amount of communicable disease transmission through cow's milk has been overestimated, but such transmission does occur in a degree of frequency which demands public protection.

The infection of milk with human disease germs may occur at any time between its secretion in the cow and its consumption.

In addition to infection with human disease germs milk may be otherwise polluted, or may decay to a degree that renders it an unsafe food for human beings.

To insure its safety as a human food two procedures of control are necessary.

First. — By inspection of cattle, methods of production and transportation, secure a supply that is pure, clean and fresh.

Second. — By the application of heat destroy all disease germs that may be in it, whether they come from animal or human sources.

There are two methods of disinfection by heat in common use: (*a*) complete sterilization by boiling; (*b*) partial sterilization — "pasteurization" — by heating the milk to between 140° and 150° F. for from twenty to thirty minutes.

Both of these methods are effective.

The partial sterilization — "pasteurization" — seems to have fewer objectionable features, and is already established in this country as an accepted, successful process.

To obtain the most perfect results, market milk, intended for human consumption as milk, should be pasteurized under the control of the health authorities.

Section C.

The infant mortality rate is still higher than it should be, — higher than investigators feel is inevitable. A still undetermined part of this excess is due to the quality of infant's food

and the method of its administration. Breast milk is the natural food for the infant. When this maternal function fails a substitute food is required. Modified cow's milk is the common substitute, although it has inherent qualities that make it an imperfect food for infants. The supply for our cities must be brought from a distance. It may become polluted at any time between its secretion in the cow's udder and its digestion in the stomach of the infant. To make it reasonably safe it should be controlled by inspection and pasteurization up to the point of delivery at the home, and controlled after delivery by the education of the mother in hygienic methods.

Section D.

The exceptional place of milk as the indispensable food for infants and invalids is emphasized. The fact that milk is a unique food in the sense of being so complete in itself that it can sustain life alone for indefinite periods is emphasized; also that it is in food value one of the cheapest of foods. Under our present conditions there is a great economic waste of a part of the milk that has in itself a high nutritious value, — that is to say, the skimmed milk.

PART VI.

Section A.

In this section the subject of grading is discussed, both from the bacteriological standpoint and from the standpoints of percentage composition and of food values. The average milk sold in Massachusetts, although considerably above the standard, is nevertheless steadily becoming more inferior in fat, the average of which in 1909 was 4.10 per cent., and in 1915 had been reduced to 3.82 per cent. The New York system of bacteriological control and its application is discussed. The commercial pasteurization of milk should be under official control, which is not the case at present in Massachusetts, and if this were done the pasteurization of dirty milk, or of milk high in bacteria, could be prohibited. A premium should be paid for milk low in bacteria as well as for milk high in fat.

Section B.

A special article is inserted in this section showing the relation between the solids and fat in known purity and commercial milk. It is evident from a study of the charts introduced that commercial milk is somewhat deficient in fat. The introduction of a grading system by which milk may be sold on its fat percentage would stop this form of adulteration, which, while too slight to be proven in a court of law, yet is sufficient to be apparent when the averages are compared with data obtained from milk of known purity.

PART VII.

In this part the experiences of other localities is discussed. Section A is a special report on the New York City grading system from investigations made in the city of New York. Sections B and C are special reports on the efficiency of the system in the producing area. Section D is a special article upon this system by Lucius P. Brown, Chief of the Food Division, New York City Department of Health. This system has been studied to the best of our ability, visits being made to the New York City Health Department, the New York State Department of Health, several New York milk dealers, one commercial chemical laboratory in New York City, to the producing territory and to one country pasteurizing station in Connecticut. Every definite complaint relative to the inefficiency of this system brought to our attention has been carefully investigated, and in all cases these complaints have been found to be without foundation. The system is substantially as follows: —

All milk except of a quality resembling certified milk must be pasteurized. If the bacteria content is high before pasteurization it must be labeled "Grade C, For Cooking Purposes Only." There are two other grades of pasteurized milk, "Grade A Pasteurized" and "Grade B Pasteurized." The Grade A milk is obtained from better stables, and has a lower bacteria content before pasteurization than Grade B milk. Section E gives a report of information regarding the experience

of other localities gathered at the Convention of Milk and Dairy Inspectors in Washington, D. C., from conversation with the milk inspectors of various cities and towns of the United States. This report cannot be further summarized.

In Section F is given an abstract of the laws and regulations relative to milk in force in various States and municipalities in the United States. This report is of such nature that it cannot be further abstracted.

CONCLUSIONS.

Cow's milk is an invaluable article of diet.

In the interest of the public health its use as a food should be maintained and extended.

Healthy animals and proper methods are more important than equipment in the production of clean, wholesome milk.

Epidemics of disease have not infrequently been caused by raw milk, but the amount of communicable disease so transmitted is much less than has been often asserted.

Pasteurization.

Pasteurization or sterilization is the only practical method for insuring the safety of commercial milk.

No epidemic has ever been traced with certainty to pasteurized milk.

The present uncontrolled method of pasteurization does not furnish a satisfactory safeguard to the public.

To make certain of the adequacy of the processes of sterilization or pasteurization, the responsibility therefor should rest upon public health officials.

Employees in commercial pasteurizing plants should be subjected to routine physical examination.

Pasteurization should not be allowed to be used to conceal an inferior quality of milk.

Milk in the Possession of the Consumer.

Fresh milk has a greater food value than other milk.

Milk, while in the possession of the consumer, should be no less scrupulously cared for than while in the hand of the producer or dealer.

(a) It should be immediately placed in a cool place and kept there, duly protected, until used.

(b) All milk bottles received by the consumer should be washed with soap and hot water as soon as the milk has been removed, and should be kept clean until returned to the dealer.

(c) Milk bottles should never be used for anything but milk, as is provided for by statute.

Tuberculosis.

In addition to epidemic diseases, the evidence is now conclusive that a very considerable proportion of tuberculosis in children is due to infection by the bovine type of tubercle bacilli taken into the body by drinking raw milk.

Bovine tuberculosis is prevalent to a dangerous degree in ordinary dairy herds.

Dairymen should attempt to eradicate tuberculosis from their herds, not only in the interest of public health, but also to improve the quality of their young stock.

Adequate pasteurization as effectively destroys tubercle bacilli as it does the germs of epidemic diseases.

Milk for Infant Feeding.

Cow's milk is decidedly inferior to mother's milk as a food for infants, but clean cow's milk is the best as well as the most common substitute for mother's milk.

Some part of our excessively high infant mortality rate is probably due to unwholesome qualities of the cow's milk furnished to infants. It is generally admitted, however, at present, by children's specialists and sanitarians, that the use of cow's milk regardless of quality furnishes only one among many factors in the total causes of infant mortality.

There appear to be some grounds for concluding that in some cities of this Commonwealth the inadequacy of the total supply of cow's milk for infants and young children is a more serious public health problem than any existing deficiencies in quality.

Existing Inspection.

The present laws for the supervision of milk production and distribution in Massachusetts give ample authority to the cities and towns to protect their milk supplies in as stringent and thorough a fashion as they may see fit.

These laws make it mandatory upon cities and towns to carry out thorough dairy inspection in all dairies supplying milk for their consumption.

The present system of sanitary supervision of milk by local authorities is in the aggregate costing the people of the Commonwealth fully as much if not more than a complete, well-balanced, uniform system of control.

As these laws are carried out the practical results are (1) that the inhabitants of many cities and towns receive no protection whatsoever, and the inhabitants of many other cities and towns receive protection at the expense of the taxpayers in neighboring cities; (2) responsibility is divided, official friction between cities and towns is incurred; (3) the literal carrying out of the laws would result in an inconceivable mass of overlapping inspections; (4) the producer not having a fixed standard, owing to the changing and contradictory orders of local milk inspectors, is confused and discouraged.

State Control.

There is no law at present providing for State control of the milk supply of this Commonwealth relative to the public health.

The systematic dairy inspections instituted in this State by the State Board of Health, and subsequently carried on by local authorities, have been productive of improved dairy conditions and an improved milk supply, many producers having taken advantage of the opportunities of obtaining valuable information from the inspectors.

The clean milk contests of the State Board of Agriculture have been productive of much good among those producers who distribute milk of their own production direct to the consumer.

Milk production should be so supervised as to result in a maximum of cleanliness and safety with a minimum of interference with the milk industry.

Sale of Milk. Prices.

At the present prices, or even at considerably higher prices than those prevailing at present, milk is one of the most economical of foods.

There are no reasonable grounds for believing that the retail price of milk can be lowered.

Milk should be bought and sold on its merits as determined by its chemical and bacteriological condition rather than by volume only. This should include higher price for higher fat content and higher price for low bacterial content.

Massachusetts Dairies.

Massachusetts dairymen must produce milk of a superior quality if they are to hold the confidence and patronage of the consumers of the Commonwealth.

As far as statistics are available it would appear that Massachusetts dairymen produce more milk per cow than dairymen of neighboring States and countries, and produce it under generally better conditions as to cleanliness.

Nevertheless, milk production in Massachusetts has rapidly decreased since 1890.

To supply the steadily increasing population of the State with milk and cream, the large dealers of Boston and other cities have been going to points in other States (principally Maine, Vermont and New Hampshire) and the province of Quebec to secure adequate supply.

The great distance of some of these points, together with careless handling and slow transportation, tends to place a large amount of milk on the Massachusetts market which is less desirable than milk produced near by.

Sufficient milk to supply Massachusetts people could be produced within the borders of the State if the thousands of acres of naturally good dairy lands now lying idle were stocked with milch cattle.

The principal reason for the decline in dairying in this State is the low price paid to producers.

Other causes are the increase in the cost of cows, grain, building materials, labor and the improved methods demanded by State and municipal authorities, as well as constant legislative agitation for several years.

Milk can be bought at lower prices at out-of-State points than Massachusetts farmers can produce it with profit.

Milk transportation rates are lower in proportion for long haul than for short haul.

Massachusetts dairymen have been in general subjected to a more rigid enforcement of dairy rules and regulations than out-of-State producers of milk.

Massachusetts dairymen furnishing milk for near-by consumption must compete with an inferior grade of milk produced out of State, which has been freed from disease germs by pasteurization, and has been rendered macroscopically acceptable to the consumer by clarifying processes to remove filth originally introduced by slovenly dairy methods.

Owing to the fact that in Massachusetts there are scarcely any country-receiving milk stations, milk produced in Massachusetts must be marketed more quickly than milk produced out of State which has been clarified and pasteurized before being shipped.

It would be an advantageous practice if Massachusetts dairymen would label State-raised milk as Massachusetts Milk, particularly if a State authority could, after examination, permit its sale as a distinct grade of milk.

PART I. HISTORICAL.

A. DEVELOPMENT OF PRESENT MILK CONTROVERSY.

It would be hard to say when the milk business became the subject of discussion between various interests, but probably at a time more than twenty years ago it became a subject of bitter controversy between producers and the so-called contractors; dairymen claiming that they were not paid a fair price for milk, and that the surplus system and some other features made it an absolutely losing proposition to produce milk to be sold to the large dealers. Complaints were numerous of the methods employed in transportation. The many ways in which the farmers had been, or claimed to have been, defrauded, either by a system of discounted price for surplus milk or by the failure of dealers to pay for the milk, added to the confusion. Efforts were made by different organizations, either of Massachusetts or New England dairymen, to eliminate some of the troubles, but it seems that they were not successful, as we hear the same complaints to-day about the price of milk and of transportation methods. So bitter were the controversies between the producers and the large dealers that many of the dairymen either reduced the amount of milk production on their places or went out of business altogether.

On the other hand, the contractors have claimed that the price they paid was all that was possible, when the cost of handling and the price received by them from the consumer were taken into consideration, and they have always claimed that the margin of profit was small. Many times contractors have claimed that no satisfactory adjustment of prices could ever be made until the consumer was willing to pay more for milk.

The question of transportation is still under discussion. Claims are made by different dairymen that under the present system of handling milk on the railroads they cannot market their milk to the best advantage. The railroad companies, principally the Boston & Maine, have claimed that there was

no profit, and many times a loss, in the transportation of milk, and have recently asked the Public Service Commission of Massachusetts to consent to an increase in transportation rates.

In recent years, beginning with 1906, when the first systematic dairy inspection was made by the State Board of Health, there have been many discussions as to the right and justice of the dairy inspection as conducted by the State or local boards of health. Inspection methods have received a great deal of criticism, and complaints made that the multiplicity of inspections has tended to make the production of milk a very unsatisfactory business. The positions taken by certain health authorities and prominent social workers that milk was the cause of much disease and many deaths among infants of our large cities, and many published reports of cases of diseases and deaths caused by milk-borne epidemics, have been assailed by many dairymen as unjust and tending to harm the business to such a degree that the business is becoming less profitable on this account as well as on account of the activities of the inspectors. The result of these controversies between producers, contractors, health authorities and organizations has been the introduction of legislative bills that have generally served to keep up the constant agitation.

The following have taken more or less active part in the discussion of milk conditions in Massachusetts, but have seemingly never arrived at any definite conclusion or settlement of the situation: The Boston Chamber of Commerce, the Grange, State Board of Agriculture, the Department of Animal Industry, Milk Consumers' League, labor organizations, Milk and Baby Hygiene Associations, the contractors, medical societies and others.

In the year 1912 efforts were made to bring together the State Board of Health, the State Board of Agriculture, and the executive committee of the Massachusetts State Grange and various dairymen, so that there might be, if possible, a settlement of some of the difficulties in the milk business.

The local milk inspectors have generally appeared at legislative hearings, and have taken an active part in opposing legislation tending to centralize the authority of milk inspection;

but up to the present time there has never been any legislation that would satisfy all of the parties concerned, and the future must decide how this vexatious problem can be fairly adjusted.

B. EARLIER INVESTIGATIONS.

There have been three previous investigations of the milk situation in Massachusetts carried out during the past six years. They are —

(*a*) The investigation into the cost of production, transportation and marketing of milk within the Commonwealth by a joint special committee of the General Court of 1910.

(*b*) The report of the special commission, consisting of the members of the Dairy Bureau, of the State Board of Agriculture and two additional members appointed by the Governor, authorized by a resolve of the General Court of 1910.

(*c*) The report of the special committee on milk of the Boston Chamber of Commerce, issued in July, 1915.

Your Board has made a careful and intensive study of the subject-matter of these three reports, and as far as they have been available have examined the original data upon which these reports are based.

In the case of the first report, through the courteous cooperation of the Hon. Charles M. Gardner, a member of this committee, your Board has had access to and has thoroughly studied for several months past the verbatim testimony presented at the numerous hearings of this committee.

In the case of the last report, through the courtesy of the officials of the Boston Chamber of Commerce, especially Mr. John C. Orcutt, assistant secretary of the Chamber of Commerce, in charge of this investigation, your Board has had access to practically all the facts upon which this report is based.

In the case of the second investigation in the introduction to that report the following sentences occur: "The first step was to secure and place on file for reference as complete data as were obtainable from every State which has a system of milk inspection. This resulted in the collection of a vast amount of information regarding milk inspection and handling. All these data have been studied, compiled and tabulated, and put

in concise form for future reference." Persistent and diligent inquiry addressed to all the individual members of this Commission has failed up to the present to unearth any of these data referred to for our enlightenment. We may add parenthetically that this striking example of how easily valuable data, compiled for the express purpose of having them accessible for future reference, become completely lost to sight in a few years' time has been the cause, to no small degree, of your Board adopting a radically different policy in reference to the data that we have compiled. We feel that we might also fairly lay claim to having accumulated at least a considerable "amount of information," but we have included practically all of it, that in our opinion has any direct value to the question under investigation, in either the body of our report or among the appendices.

(a) **Abstract of the Report of the Special Joint Milk Investigating Committee of the General Court of 1910.**

This committee considered themselves limited, by the terms of the order creating the committee, in their scope of inquiry to "an investigation of the methods and costs of said production, transportation and marketing."

They concluded and reported essentially as follows: —

1. That milk on the average could not be produced in 1910 in Massachusetts at an actual cost to the producer of less than 4 cents per quart.

2. That the "control" of producers by the "contractors" of the metropolitan district of Boston "tends to create and maintain a monopoly in the sale of milk, and to restrain competition in the supply and price of milk."

3. That "the cost and methods of transportation are of great importance to the consumer as affecting not only the cost of milk to him, but also its freshness." They go on to condemn the "leased car" system on this basis, and specifically recommend repeal of certain sections of the (then) transportation statutes, and the substitution therefor of the "flat-rate system."

4. That there was no definite proof of any collusion between the different "contractors" as to price and territory, but the committee, on the contrary, express themselves satisfied that the contractors are truly competing with each other, and also

that the contractors are making a fair profit on their investment.

5. That regular and adequate sanitary inspection of market milk is necessary in the interests of the public health.

6. That this (*i.e.*, work of milk inspection) cannot be properly and economically done by the health officers of the several cities and towns. It should be done by some central authority. To do this "requires an examination of existing laws, the enactment of new, and the repeal or modification of existing laws which would consume much time." They then recommend that the Dairy Bureau be charged with the duty of formulating a general bill to cover these points.

This report was signed by five of the seven members of the committee, one member concurring in all except the recommendation for further reference to the Dairy Bureau, urging the formulation and passage of immediate corrective legislation; one other member concurring in the minority opinion, and also filing an opinion that the joint special committee itself should have recommended specific legislation to "remedy the abuses and the iniquities of the present transportation system."

(b) Report of the Committee on Inspection of Milk of 1910.

Following the recommendations of the special joint committee on milk of the General Court, a resolve was passed directing the Dairy Bureau of the State Board of Agriculture, "together with two additional persons to be appointed by the governor," to prepare a bill for the inspection of market milk in all its stages from cow to consumer, to make such amendments as would eliminate duplication of inspection or conflicting provisions in existing laws, and to thoroughly cover the sanitary aspects of the milk question.

The Commission held hearings, traveled to other points in the United States, and did more or less inspecting of dairies and milk plants, as well as examining the laboratory equipment for milk examination of various cities, and conferring with local health authorities.

They found existing duplication of laws and of law enforcement, but rather strangely make no reference in their report to the large number of cities and towns in which no real milk

inspection or supervision of any kind existed (for your Board's investigation reveals the fact that in 1910 there was even less supervision of milk by local authorities than at present). They concluded that existing laws operated to the disadvantage of Massachusetts producers as competitors with out-of-State producers.

They recommended a State-administered uniform system of milk inspection enforced by a special State Milk Board, which body should have broad legislative and executive powers.

They point out that both the sanitary and economic aspects of milk production demand reasonable consideration, and urge that no system of State inspection of milk be put into effect unless funds are available to adequately enforce it.

A minority report signed by the two appointed members agrees in the general scheme proposed, but dissents from the recommendation for a Special Milk Board, recommending in the place of it that "the milk act and its regulations should be administered by the State Board of Health, in a milk division established for this purpose."

The direct result of this investigation and report has been an annually recurring crop of proposed acts to settle the milk questions of the Commonwealth, none of which have ever become enacted. (Their provisions are discussed in the following section.)

(c) The Boston Chamber of Commerce Report of 1915.

Recently the Boston Chamber of Commerce has made an extended report upon an investigation into the milk situation of New England. This report naturally and properly confines itself largely to the "business aspects of the milk problem." It also takes up the entire question from a New England rather than from a Massachusetts standpoint.

The salient features of this report are that the milk industry of Massachusetts is steadily shrinking, but that under certain conditions it might be revived. This result in the opinion of this committee might be brought about by establishing uniform systems of grading and labeling throughout New England (method by which same is to be accomplished not specified); by development of co-operative receiving stations by the producers; by better bookkeeping by farmers; by reform of trans-

portation methods; by improvements in distribution systems; and by advertising more widely the comparative food value of cow's milk.

Your Board has found in many quarters of New England, especially among producers, a deep-seated skepticism as to the impartiality and real reason for this Boston Chamber of Commerce investigation. This has usually taken the form of a direct charge that the entire investigation was undertaken and carried through at the instigation of transportation interests. If there be any truth in this very widespread impression, a careful study of the report itself does not reveal any definite internal evidence to support it.

C. SUMMARY OF PROPOSED LAWS RELATING TO MILK.

The following is a list of laws which have been proposed for the control of the production, handling and sale of milk in the State of Massachusetts during the past five years.

Proposed, 1910.

1. To permit Boston to control its own milk situation.
2. Prohibiting mixing anything with the whole, raw milk.
3. Providing for milk board of three from State Board of Health, three from Dairy Bureau, to make regulations to be enforced by local board of health.
4. Providing State Board of Health to make regulations to be enforced by local board of health.
5. Providing Dairy Bureau to draft bill which would wipe out conflicting and duplicating inspections.
6. Providing commission to investigate milk from cow to human stomach.
7. Regulating railroad rates for transportation.
8. Repealing present laws (Acts of 1906, chapter 463, Part II., sections 202 to 204) which attempt to regulate railroad rates and methods.

Proposed, 1911.

In 1911 five bills were proposed for regulation, all mainly identical, but differing chiefly as to who should make and who administer the regulations.

1. State Board of Health to make and administer rules and regulations. (House 1332.)
2. Unpaid board, three from Board of Health, three from Board of Agriculture; to make and administer. (House 1476.)

3. Paid board, two from Board of Health, two from Board of Agriculture, and one chosen by these, to make regulations. Administration in local boards of health. (House 1943.)
4. No pay mentioned. Appointed by the Governor, — two medical men, two practical producers, one sanitarian; to make regulations. Administration in Milk Division, State Board of Health. (House 2002.)
5. Paid board, appointed by the Governor, five members, two medical and two producers; to make and administer regulations. (House 2054.)

The following bills were also proposed: —

1. Requiring license for all dealers without reference to amount sold or to whom sold. (House 361.)
2. Authorizing establishment of milk-distributing stations. (House 496.)
3. Labeling milk. (House 1319.)
4. Providing standard bacteria count not over 500,000. (House 1130.)
5. Any city or town to issue permits. (House 350.)

Passed, but vetoed, 1911.

House 2082, passed and vetoed by Governor Foss, was identical with House 2002, except as follows: —

House 2002 prohibited selling without a permit by dealers except "those selling to others than consumers." This bill prohibited selling without a permit by dealers except "those selling solely to others than consumers." (Section 4.)

House 2002 stated: "This bill not to be construed to make legal what is now prohibited nor to affect present local regulations." (Section 20.)

House 2082 added, "provided said municipal regulations do not conflict with this act nor with regulations which may be made under it."

Proposed, 1912.

1. No pay mentioned. Five members appointed by Governor with advice of Council, — two medical, two producers, 1 sanitarian; to make regulations. Administration, State Board of Health. (House 1570, Ellis.)
2. Paid board, six members; three from State Board of Health, three from State Board of Agriculture; to make regulations. Administration by local boards of health. (House 1571, Meaney.)
3. Giving full power to State Board of Health to make and administer regulations on milk question. (House 1049, Withington.)
4. State Board of Health to make regulations subject to approval by Governor and Council, and requiring publishing in advance of approval. (House 1568, Fowler.)

Proposed, 1913.

1. Authorizing local board of health to issue permits or forbid sale. (House 612, City of Boston.)
2. Stating many prohibitory conditions, including maximum bacteria count of 200,000 to be administered by State Board of Health. (House 1569, Putnam.)
3. Almost identical with House 1568, 1912, except instead of State Board of Health making and administering rules and regulations, a special milk board of five members, appointed by the Governor and Council, — two medical, two producers, one sanitarian, — is provided; regulations to be published and then approved by Governor and Council, then to be administered by State Board of Health. (House 393, Bradley.)

Proposed, 1914.

1. Relative to inspection of dairies and cows and of barns and other enclosures where cows are kept for the production of milk. Except in case of contagious disease now under jurisdiction of State Board of Health, no other inspection shall be made than that by the Commissioner of Animal Industry, such inspection to be made under such regulations as agreed upon by State Board of Health and said Commissioner. (Senate 234, Moore.)
2. Relative to inspection by boards of health of milk and other articles of food with right to seize unwholesome or unfit milk or food. (House 877.)
3. Relative to licensing of persons, partnerships, corporations, except the producer selling to others than consumers or not to exceed five quarts per day to consumers, in cities or towns where a milk inspector is appointed. (House 588, McGrath.)
4. Providing for State milk regulation board to make regulations for production, transportation, keeping and sale of milk; five members appointed by Governor with advice and consent of Council, two learned in the science of medicine or bacteriology, two practical producers and one sanitarian. Rules and regulations to be approved by Governor and Council and administered by State Board of Health or other municipal boards of health. Appropriation $50,000. (House 775, Bigelow.)
5. Safeguard the public health from dangers of milk injurious to public health. Boards of health of any city or town authorized to exclude milk or cream deemed to be injurious to health. Prohibiting the bringing into the State for sale in any city or town such milk or cream as may have been condemned. Penalty $25 to $100. (House 780.)
6. Terms "milk" and "pure milk" to be defined. The terms "milk" and "pure milk" as used in section 55 of chapter 56 of the Revised Laws to apply to cream, buttermilk or any fluid or semi-fluid product

of milk except evaporated, concentrated or condensed milk when not diluted with water, which is to be employed as milk, cream or buttermilk. In the manufacture of evaporated, concentrated or condensed milk the use of cane sugar is permitted. (House 781.)

7. For further regulations of prosecutions in milk cases. A dealer of milk not to be liable to prosecution unless the sample of milk which it is charged he has sold, exchanged, delivered or had in his possession with intent to sell, exchange or deliver was taken upon his premises or while in his possession by the inspector of milk or by the agent of the Dairy Bureau or of the State Board of Health, and a sealed portion thereof was given him at the time of taking. (House 934, Connor.)
8. Regulation of sending of results of analysis of milk by inspectors. Amending section 63 of chapter 56 of the Revised Laws so that such inspectors shall send to persons responsible for the condition of sample of milk the results of the analysis within three days. (House 935, Connor.)
9. Massachusetts Milk Consumers' Association for protecting the public health and the promotion of the milk industry of the Commonwealth. State regulation, milk board; five men appointed by the Governor with the advice and consent of the Council, two learned in medicine or bacteriology, two men of practical experience in the production of milk and one sanitarian. Regulations to be approved by Governor and Council and administered by State Board of Health and municipal boards of health under supervision of State Board of Health. Permits from State Board of Health to sell milk. Creation of milk division of State Board of Health, with chief of division and milk inspectors not to exceed twenty in number and such other employees as necessary. Appropriation $50,000. (House 936.)
10. To prohibit the sale of milk and milk products produced under insanitary conditions. Fine of not more than $300 or imprisonment for sixty days, or by both. Supreme Court to have jurisdiction in equity upon appeal of State Board of Health or any local board of health to enjoin sale of such milk or milk products. (House 937, Sullivan.)
11. To exclude out-of-State milk not produced or handled under sanitary conditions. The State Board of Health is authorized to spend for salaries and expenses for necessary inspection of dairies, creameries, stores and contractors' plants, railroad cars used for the transportation of milk, and other conveyances and places outside the State in which milk, cream or their products are stored when they are intended for sale within this State. Appropriation $35,000. Penalty $300 or ninety days' imprisonment, or both.

Milk to be labeled or marked by name of State in which it was produced, and also what artificial treatment, if any, has been employed, as

"Massachusetts Milk," "Maine Milk," "New York Milk," etc.; "pasteurized," "natural," "modified" or "compound milk." Milk pasteurized two or more times shall be so marked. Penalty clause not filled in. (House 1409, John J. Lydon.)

12. Amendment to law relative to inspection and sale of milk. Sample of equal size, sealed and delivered to the person having milk sampled at the same time when sample is taken for analysis. Results of analysis to be sent to party within five days. Twenty-day clause for producers. Cities of 50,000 population or over shall cause all milk or cream sold therein to be pasteurized at 145 degrees F. for thirty minutes. All milk inspectors, as provided by law, shall publish monthly records of analyses and names of persons from whom samples were taken. (House 1408, Murray.)
13. Producers of milk shall be reimbursed for damages suffered from non-sale of milk during epidemics as a result of orders of boards of health. (House 1520, Kimball.)
14. Every city and every town of over 6,000 population shall establish public milk stations in charge of milk inspectors or other persons designated by local boards of health. Distribution shall be made for the sole purpose of benefiting persons whose personal or family conditions make it imperative that they be entitled to the benefit thereof, the price of the milk to be subject to the control of the local board of health, with the right of appeal to city council or board of selectmen. Milk to be inspected once a week at least to avoid danger. Business shall be conducted so that no financial loss to distributors shall take place or to establish no offensive competition with local dealers. (House 2104, Arkwell.)
15. To authorize cities and towns to compensate certain owners of milk at prevailing wholesale rates when owners are prevented from selling by orders of boards of health because of presence of contagious or communicable disease. No compensation if existence of disease is due to negligence or fault of owner. (House 2158, Putnam.)
16. Relative to inspection by boards of health of milk and other articles of food. Right to seize unwholesome or unfit milk or food. (House 2156.)

D. SUMMARY OF PRESENT MILK LAWS.

Boards of health of cities shall, and boards of health of towns may, appoint milk inspectors, compensation determined by the appointing boards. (Acts of 1909, chapter 405, amended by Acts of 1910, chapter 114.)

No person in the milk business shall be appointed an inspector of milk. (Acts of 1910, chapter 457.)

Each inspector shall be sworn and shall publish his appoint-

ment for two weeks in a newspaper. (Revised Laws, chapter 56, section 51.)

Inspectors shall keep an office, and record in books the name and place of business of all persons engaged in the sale of milk. The board of health may employ collectors who shall be sworn. The inspectors or collectors may enter premises and take samples of milk. They shall upon request make sealed samples, a receipt for which must be given to the inspector. The inspectors shall cause such samples to be examined, and shall keep a record of the analyses. If sealed sample is refused no evidence of the analysis can be introduced. (Revised Laws, chapter 56, section 52, amended by Acts of 1909, chapter 405.)

The State Department of Health may appoint inspectors, analysts and chemists. Inspectors have the same authority to collect samples as is given to inspectors and collectors of milk. (Revised Laws, chapter 75, section 5, amended by Acts of 1910, chapter 394.)

The State Department of Health has appropriation of $17,500, three-fifths of which must be spent for the enforcement of milk laws. (Revised Laws, chapter 75, section 6, amended by Acts of 1903, chapter 467; 1907, chapter 208; 1911, chapter 296.)

The Board of Agriculture at its annual meeting appoints a general agent of the Dairy Bureau. The Dairy Bureau consists of three members, one of whom is appointed annually by the Governor for a term of three years. The secretary of the Board of Agriculture is the executive officer of the Bureau. The Bureau inquires into the methods of butter and cheese making, and enforces the laws relative to the sale of all dairy products and their imitations. The Bureau has an appropriation of $8,000 per annum. It may co-operate, but must not interfere with the State Department of Health and with inspectors of milk. The agents of the Bureau have the same authority as is given to inspectors and collectors of milk. Penalty for obstruction, first offence, $100; subsequent offences, $200, with fine payable to the Treasurer of the Commonwealth. (Revised Laws, chapter 89, sections 5, 11, 12 and 13, amended by Acts of 1891, chapter 412; 1892, chapter 139; 1894, chapter 280; 1895, chapter 214; 1900, chapter 368; 1905, chapter 155; 1907, chapter 401; and 1908, chapter 416.)

Unlawful to sell milk without a permit. Permits are issued by local boards of health after a satisfactory inspection of the milk and of the dairies and of the premises upon which the milk has been handled. No charge for inspection. These inspections must be made by the authorized agents of the board. The boards may require such reasonable conditions as they see fit. If a permit is revoked the board of health must notify the State Department of Health. The latter must notify other boards of health in whose jurisdiction the milk is liable to be sold, and must notify dealers liable to purchase the milk. Unlawful to sell after receiving such notice. Permits may be reissued by local boards of health. Penalty not more than $100. (Acts of 1914, chapter 744, amended by Acts of 1916, chapter 228.)

Unlawful for any State or municipal inspector to charge for the inspection of live stock, dairy, etc. (General Acts of 1915, chapter 109.)

No person shall sell milk without a license. Exception: a producer selling to dealers or not more than 20 quarts to consumers. The license shall be numbered and shall contain the name, place of business, residence, number of wagons and names of drivers, and shall be conclusive evidence of ownership. Name, place of business and license numbers must be painted on wagons, and license must be posted in stores. Penalty for operating without a license, first offence, $10 to $100; second offence, $50 to $300; third offence, $50 and imprisonment for thirty to sixty days. Fee for license, 50 cents. License remains in force until the first day of June. May be revoked for violation of the terms of the license. If license is revoked licensee has an appeal to the State Department of Health, whose decision shall be final and conclusive. (Acts of 1909, chapter 443.)

Utensils used in determining fat by the Babcock or other centrifugal methods must be approved or calibrated by the Massachusetts Agricultural Experiment Station. Persons operating these machines must have a certificate from the experiment station. Exception: persons doing such work for their own information, not for inspection or as a basis for payment in buying or selling. Penalty, $15 to $50. (Acts of 1912, chapter 218.)

Milk which has been heated to a temperature greater than 167° F. must be labeled "Heated Milk." Penalty, first offence, $50 to $200; second offence, $100 to $300; subsequent offences, $50 and imprisonment for sixty to ninety days. (Acts of 1908, chapter 570.)

Sale, etc., prohibited of adulterated milk, or milk to which water or any foreign substance has been added, or milk from cows fed on the refuse of distilleries, or from sick cows, or as pure milk, milk from which a part of the cream has been removed, or skimmed milk containing less than 9.3 per cent. solids not fat. Penalty, first offence, $50 to $200; second offence, $100 to $300; subsequent offence, $50 and imprisonment for sixty to ninety days. (Revised Laws, chapter 56, section 55.)

Sale, etc., prohibited of milk below the legal standard. Penalty, first offence, not more than $50; second offence, $100 to $200; subsequent offences, not more than $200 or not more than ninety days. (Revised Laws, chapters 56 and 57, amended by Acts of 1910, chapter 641.)

Producer not liable for sale of low standard milk unless low in both solids and fat, and unless twenty days after he has received notice of this fact a second sample is found by the same inspector to be low in solids and fat. Furthermore, samples must be taken while in his possession or in his control by an inspector, and a sealed sample given. (Revised Laws, chapter 56, section 62, amended by Acts of 1910, chapter 641.)

Standard: solids, 12.15 per cent.; fat, 3.35 per cent. (Revised Laws, chapter 56, section 56, amended by Acts of 1908, chapter 641.)

Skimmed milk may be sold if labeled with the words "Skimmed Milk" in letters 1 inch in length. (Revised Laws, chapter 56, section 58.)

Use, etc., of counterfeit seal, or tampering with sample, punished by fine of $100 or imprisonment three to six months. (Revised Laws, chapter 56, section 60.)

Obstruction of inspector punished by fine of $100 to $300 or imprisonment thirty to sixty days. (Revised Laws, chapter 56, section 61.)

The inspectors must make complaint upon receipt of evidence. (Revised Laws, chapters 56 and 64.)

Analyses of samples must be sent to the person from whom sample was taken. (Revised Laws, chapters 56 and 63.)

Use of unclean containers and implements punished by fine of not more than $50. (Acts of 1913, chapter 761.)

Placing substances other than milk and milk products and cleaning fluids in milk cans or bottles punished by not more than $10 for each vessel misused. Returning dirty cans to producers punished by fine of not more than $10 for each such vessel. (Acts of 1906, chapter 116.)

Milk dealers must not use cans not their own. Penalty, $10. (Acts of 1906, chapter 116, amended by Acts of 1908, chapter 435.)

Commissioner of Animal Industry may inspect premises where cattle, etc., are kept. He may make and enforce regulations for the sanitary condition of the premises subject to approval by the Governor and Council. State Department of Health, Dairy Bureau and boards of health must report all premises found to be unsanitary. Penalty for obstruction, not more than $50 or imprisonment not more than thirty days. (Acts of 1911, chapter 381.)

Feeding garbage collected by a city or town to milch cows prohibited. Penalty not more than sixty days or not more than $100. Feeding garbage collected from a city of more than 30,000 inhabitants to any animal except swine prohibited. Penalty, not more than thirty days or fine not more than $50. (Revised Laws, chapter 213, section 5.)

Medical milk commissions may be formed. The members of the board of health may be *ex officiis* members. Members shall receive no compensation. The corporation may make agreements for the production of milk under their supervision, but the conditions shall not fall below those imposed for certified milk by the American Association of Medical Milk Commissions, or below the statutory standard. Penalty for sale of milk not conforming to the regulations, not more than $100. (Acts of 1911, chapter 506.)

Boards of health of cities and of towns having 10,000 or more inhabitants may establish stations for the distribution of milk free of charge or at such charge as the board may establish. The boards, however, must not engage in the general milk business. (Acts of 1911, chapter 278.)

PART II. STATEMENTS OF VARIOUS INTERESTS.

INTRODUCTION.

It was the desire of your Board to obtain as many viewpoints from as many different interests concerned in the production and the sale of milk as possible, and therefore a number of letters were sent to different organizations.

A questionnaire of nine questions was sent to certain of the large milk contractors; six questions requested definite information upon certain phases of the operation of their business, and three were relative to their opinion of the present milk situation. Letters were sent to cattle breeders' associations asking whether or not they would approve of selling milk upon its fat percentage. A letter was sent to the State Department of Animal Industry relative to the inspection of cattle, and that Department was asked to give an opinion upon the health of Massachusetts cattle at present as compared with that in former years.

The Boston Chamber of Commerce, the State Grange, the Milk Consumers League, the Milk and Baby Hygiene Associations, the Massachusetts State Board of Agriculture and the Health Department of the city of Boston were all requested to submit statements giving the viewpoints of their respective organizations relative to the milk situation in Massachusetts.

The answers, wherever possible, have been reported in full, but in a few instances it has been necessary to make compilations.

A. MILK CONTRACTORS.

A questionnaire was sent to milk contractors, a portion of which dealt with their opinions relative to the milk situation.[1] From the answers received the following has been compiled: —

Question 7. — Do you consider that the present competitive system of retail milk delivery involves an unnecessary duplication of equipment and labor?

[1] The balance of the answers are discussed in Part III., Section B.

To this question 7 answered no, 3 yes, and 1 gave no answer, stating that he made no retail sales. One complete answer is as follows: —

7. In large centers of population where the business is of considerable volume that is carried on and operated by a dealer, we think that there is little chance to improve upon the city milk delivery. A number of years ago, when the distribution of milk was in the hands of milkmen who ran one or two teams, there was of necessity long drives and scattered deliveries. One can readily see the way the business is now carried on by large dealers, — a customer moving from one section of the city to another is simply transferred to the team delivering in that section; but under conditions that existed as referred to above, the small milkmen who operated one or two teams would either have to give up the customer who moved to another part of the city, or lengthen out his drive, which, of course, is a costly thing to do. We try to load up our wagons and divide the territory so that we give one man a full day's work, and also try to arrange the deliveries so that one horse is all that is necessary usually to run the team.

Question 8. — Is there a surplus or a shortage of milk at different seasons of the year in your milk producing territory, and if so, please state your opinion of the reason therefor.

All eleven answered yes to this question. The variation in the amount of milk upon the market was explained by natural causes, unavoidable causes and faults of production. The cows are generally allowed to freshen in the springtime, and the farmers do not attempt, as a rule, to control the flow of milk by regulating the time of breeding.

On the other hand, the demand for milk varies with the temperature. During the extremely hot days there is an enormous demand for milk without a corresponding increase in production. The present shortage in the hot weather is not so severe as formerly, owing to the fact that many farmers are beginning to arrange their herds so that more milk will be produced during the hot weather.

One complete reply is as follows: —

8. Generally speaking, there is marked irregularity in the production of milk, the largest quantity occurring in the months of May and June, and the smallest in the months of October and November. Both the excess production and the under production from the average level result

in heavy cost to the industry. In the case of surplus no use is available which will yield the full cost of the milk, and in the case of shortage the supply has to be replenished from new sources of exorbitant prices.

Notwithstanding instruction to producers as to the need of the market for even production, and notwithstanding the application of a heavy grade in prices, the producer, in general, persists in uneven production. This is due, presumably, to the tradition of producing maximum amounts on summer pasturage, and again, to the consideration that milk on most farms is not the sole product, and the production of milk is not intensively carried on.

Question 9. — Do you consider the present milk situation in Massachusetts satisfactory from the dealer's point of view? If not, would you kindly state in your opinion what changes could or should be made to place the business on a more satisfactory basis?

To this question seven answered no, two answered yes and two gave no answer. The following suggestions were made: —

Increase the license fee to $50, which will prevent incompetent men from going into the milk business, and, furthermore, prohibit by statute any person engaging in the business without adequate equipment.

Milk from uninspected sources and of doubtful origin is now allowed to compete with Massachusetts producers. To offset this, uniform regulations should be made, placing the enforcement of dairy inspection in the control of the State Department of Health.

Another contractor stated that multiple inspection under the provisions of chapter 744 of the Acts of 1914 should be stopped in favor of State Department of Health inspection. Another contractor suggested lessening the legislative activity, and placing the inspection of dairies under the control of the State Department of Health. One contractor suggested compulsory pasteurization of milk in large cities under the supervision of the State Department of Health.

Price cutting is stated to be ruinous among dealers, as is also the practice of selling bottled milk in stores at cost. The selling of milk on its quality by different grades would give the consumer a reliable basis for a differentiation of quality, and would standardize competition among dealers. Another contractor with this same idea suggested statutes permitting the sale of standardized milk and the sale of milk on the fat basis.

The present conditions do not encourage milk production in Massachusetts. Long-distance milk is cheaper and discourages home production. The Saunders law did not handicap dealers in getting milk, but probably has been of no benefit to Massachusetts producers.

Another contractor suggested amending the laws so that dealers may be seen on the street corners together without danger of arrest. One complete reply is as follows: —

9. Under the law of 1914 cities and towns of the State are required to inspect and to license dairies supplying them with milk. This results in a multiplication of permits, to the extent that producers supplying dealers covering greater Boston may have permits from twenty boards of health. We believe the interests of all concerned in milk, viz., the producer, distributor, board of health and consumer, would be more agreeably, effectively and economically served by centralizing the inspection of dairies under the authority of the State.

We believe that the pasteurization of milk in the large cities of the State should be made compulsory, and that the process should be carried on under conditions prescribed by the State Department of Health.

We believe that the sanitary problem in milk has resolved itself chiefly into an economic problem. Knowledge as to the sanitary measures required for producing and handling clean and safe milk is widely disseminated. What lacks is the application of this knowledge, which is a business matter. The establishment of the sale of milk on a basis of quality through the definition of grades would afford the consumer a reliable basis for the differentiation of quality, would standardize competition among dealers, and would permit compensation of producers on a basis of quality. The consumer could then have the grade of milk desired by paying the appropriate price. We accordingly urge the establishment of grades for sale of milk in the large cities of the State.

We urge the enactment of law prescribing the sale of cream on a basis of fat.

The present requirement of law of 9.3 per cent. solids not fat in skimmed milk is higher than genuine milk will show. We therefore urge a change to 8.75 per cent.

We recommend that the boards of health of the towns and cities in greater Boston standardize their regulations controlling the delivery of milk to homes in which an infectious disease exists. There is now considerable difference in the requirements of different localities. Generally speaking, the milk dealer is held responsible to the board of health for seeing that this is done. We believe that the householder should be made completely responsible, by such means as retaining bottles in the household until the disease is over and until bottles have been disinfected by the board of health or under its direction. Such a requirement would

be seen to cover the case of bottles bought through the stores for use in infectious households where now, according to our understanding, they escape supervision. The sale of milk in bottles through the stores now constitutes a large part of the city supply.

B. BOSTON CHAMBER OF COMMERCE.

Dec. 20, 1915.

Mr. Edward H. Williams, *Room 141, State House, Boston, Mass.*

Dear Mr. Williams: — I have your letter of December 18, in which you state that you would like to have a statement from us in regard to the milk situation.

You already have copies of our milk report, which gives a summary of the present conditions and our opinion as to what is necessary to remedy some of the present difficulties. I am enclosing a leaflet which will give you an idea of our future plans. We are just sending the third edition of this report to the press. The fourth edition will come out some time in February. It seems to us that the first thing to do is to get a wide distribution of the report, co-operating with the various agencies interested, in order that a large number of people interested in the dairy industry may become acquainted with present conditions and the suggested remedies.

Up to date, almost every agency has been looking at the suggestion from their own point of view, forgetting the bearing that the other conditions had upon their particular problem. Again, many people, in order to accomplish certain needed reforms, are so anxious to overturn in a few months conditions that have been growing for a period of many years that they generally do not succeed. After securing a wide distribution of the report, we hope that a plan can be laid out by a conference of the agencies interested, whereby the recommendations as to the particular phases of the production, transportation, inspection and distribution of milk and cream can be carried out step by step.

For instance, take the grading and labeling of milk. A pamphlet should be issued telling how grading and labeling can be really carried out; what is necessary to be done in order to interest the people, such as holding meetings of health officials, town and city authorities, dealers, producers, consumers, etc.; the equipment necessary for a laboratory, the cost of operation and cost per sample, and the cost per capita. This should be figured out according to the population of the various municipalities, showing what it would cost cities of, say, 500,000 and over; 100,000 to 500,000; 50,000 to 100,000; 5,000 to 50,000; and under 5,000. These, of course, are only fictitious divisions, and it may be found upon further study that they would have to be in different divisions. This would give in detail how the grading and labeling of milk should be carried out, and this is what the people need.

The same thing should be done in regard to every recommendation

as to country milk plants, railroad transportation, better methods of production, distribution, etc., outlining a detailed plan of just what can be done, providing the people wish to take some initiative.

Undoubtedly some legislation will have to be secured in regard to making the local standards more or less uniform as to milk and cream and ice cream; the problem of the country dairy inspection; and the granting of authority to boards of health to issue licenses for the grading and labeling of milk. Undoubtedly your Board has looked into these matters and is more or less familiar with the situation.

I am sure that I personally, and other members of our committee would be very glad to have a conference with your committee any time to discuss these three particular questions, or others pertaining to this oft-vexed and much-perplexed problem.

Very truly yours,

JOHN C. ORCUTT,
Secretary, Committee on Agriculture.

C. MILK CONSUMERS' LEAGUE.

The Massachusetts Milk Consumers' Association dates its organization from 1910. It consists of over 1,800 prominent men and about 10 women, very evenly distributed throughout the various representative districts of the State. Its purpose is: "An association formed to unite consumers in obtaining efficient inspection and a pure milk supply."

The organization was evolved from three sources, namely, Dr. Charles Harrington, former secretary of the State Board of Health, the official legislative investigating committees of 1910 and 1911, and the health committee of the Municipal League.

For several years prior to 1911 Dr. Harrington introduced bills in the Legislature designed to enable the State Board of Health to enforce its suggestions for cleanliness in the dairies supplying Massachusetts. In 1905 he appointed one State Dairy Inspector, and at his death was contemplating extending the State inspection to out-of-State dairies.

When asked by the chairman of the health committee of the Women's Municipal League what they could do to help him, Dr. Harrington suggested that they assist him in securing the passage of the bill which he had introduced. Because of the continued failure to get Dr. Harrington's bill through, it was decided to form a State organization, which subsequently took the name of the Massachusetts Milk Consumers' Association.

On May 5, 1910, a joint committee of the Legislature was appointed to investigate the milk problem. This committee, after expressing the necessity for a central authority administrating a uniform inspection of the places where the milk is produced, recommended that the Dairy Bureau investigate the subject. Acting on this recommendation the Legislature authorized an investigation by the Dairy Bureau consisting

of three members, of which Charles M. Gardner is chairman, with two experts, Dr. Milton J. Rosenau and George H. Ellis, to complete the commission.

This commission on Jan. 2, 1911, reported a bill to the Legislature known as the Gardner bill. The commission unanimously found that existing conditions were a menace to the Massachusetts milk consumers and an unfair burden upon the Massachusetts milk producers.

It was at this stage that the Milk Consumers' Association became active. The Ellis bill is simply the Gardner bill with practically only one substantial change, the details of the bills being in most cases word for word the same.

Instead of having the mixed board both pass and administer regulations, as in the Gardner bill, the Ellis bill provided that while the mixed board should pass the regulations the administration should be in the hands of the State Board of Health in order to preserve unity in health administration.

There were some other changes made at the suggestion of the milk inspectors who met at a conference called by the association for the purpose of getting their ideas. The changes made at their request were in the line of preserving local powers. Everything they asked for was put into the bill.

The bill expressed the ideas of Dr. Rosenau and Mr. Ellis, the minority members of the commission.

The efforts of the association have always had the support of the Massachusetts Medical Society and of various local medical societies and innumerable other State and local welfare organizations.

The association has constantly consulted experts on the subject throughout the country, and has from time to time made changes in the bill at the suggestion of its members and others, going as far as possible to remove controversial phrases.

Many efforts have been made to come to a common understanding with the Grange, the Grange usually being represented by Mr. Howard on such occasions.

The association has never taken any arbitrary position as to the form of the bill, only insisting on the central principle that the State Department of Health should have legal power on its own initiative, in places where milk is produced or handled, to insist upon reasonable cleanliness.

In years past a great many local labor unions indorsed the bill advocated by the Consumers' Association, but this year the State branch of the American Federation of Labor at its State convention made the fight for clean milk legislation its own, and authorized its legislative committee to introduce what was afterwards known, and properly so, as the labor clean milk bill. It was an entirely different bill from the Ellis bill, but one which was heartily supported by the Massachusetts Milk Consumers' Association. The members of the association voted almost unanimously on a referendum to support the labor bill.

After receiving the favorable report of the public health committee, it was passed by a two-thirds vote of each house, but was vetoed by the Governor.

The original Ellis bill was passed in the first year of the association's campaign, but was vetoed by Governor Foss.

D. THE STATE GRANGE.

Session of 1911, Worcester.

In view of all the aspersions cast upon the Grange and upon the farmers because of the Ellis bill episode, and the misstatements of people whose conduct cannot be attributed to ignorance, it seems fitting to cause this annual session of the Massachusetts State Grange to speak clearly and distinctly on the subject of milk inspection and concerning the Grange attitude upon health matters in this State. There are exceptions to every class as to every rule, but as a whole the farmers of this Commonwealth are as eager to sell clean, wholesome, properly handled milk as any consumer is to buy it; they are as truly interested in the health and life of little babies as are the philanthropists of any city. No one in this State will more quickly condemn a filthy and disease-breeding stable than the great mass of our farmers themselves; and in any reasonable and common-sense undertaking to improve the health conditions of the dairy industry they will lend instant and earnest co-operation.

They do insist, however, that those who essay to prescribe the conditions of milk production must at least be able to recognize a cow stable when they see one, and must understand that a farmer cannot produce any kind of milk, not to mention clean milk, unless he can get something near 100 cents for each dollar that he spends to produce that milk.

Your State master sincerely trusts that this body will in no uncertain tones pledge its belief in and its support for such measures, wherever their origin, as propose to continually improve health conditions in our milk supply, by the only means that will ever prove effective, so well expressed in the words of the Chief Executive of the Commonwealth: "What we need is to penalize the farmer a little less and encourage him a good deal more."

Session of 1912, Springfield.

Confirming further our previous State Grange attitude on the whole milk question, we may well emphasize anew our emphatic declaration of one year ago, — that the final answer to all phases of the milk problem will be found, and speedily found if sought, in the disposition to pay the farmer a fair price for clean, well-handled milk, based on the belief that milk producers of Massachusetts will make just as good milk, even up to the certified class, as the consumers want to pay for. This, finally, is the essence of the whole question, and points the way to the line of milk education to-day most needed.

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Session of 1913, Boston.

In all the maze of the milk situation it is exceedingly refreshing to find some of the milk contractors making advances to the producers for a graded scale of prices, paying according to the percentage of fat value in the milk and the degree of cleanliness it possesses. This is highly significant as the trend of the times, indicating what are to be the lines of profitable milk production for the future; especially so because this is exactly the attitude the State Grange has taken for three consecutive years, not only by action in the annual session, but by appeal before the Legislature, — that the farmer will produce from his cows just as rich milk and just as clean milk as the consumer is willing to pay for; and that in respect to cleanliness the farmer is already spending far more in equipment and in care than the consumer does pay for. Let it be hoped that a graded scale of milk purchasing will ultimately become general, with an opportunity afforded the ambitious farmer, at a price commensurate with the cost of cleanliness, to produce the most wholesome and satisfactory milk it is possible for the combination of clean, healthy cows and clean, honest cow owners to produce. This is the only line on which milk progress can ever come, and that most people are coming to see this fact is one of the most hopeful signs of the times for both milk producers and milk consumers.

E. MILK AND BABY HYGIENE ASSOCIATIONS.

For the purpose of acquiring information as to the work done by the Milk and Baby Hygiene Associations, a letter of inquiry was sent to the following associations: Society for District Nursing, Worcester; Instructive Nursing Association, New Bedford; the Lowell Guild, Lowell; Visiting Nurse Association, Great Barrington; District Nursing Association, Fall River; Sanitary Milk Committee, Lawrence; Infant Hygiene Association, Holyoke; Milk and Baby Hygiene Association, Malden; Baby Clinic Day Nursery Association, Lynn; and Miss Helen Dalton, Fitchburg. The letter was as follows: —

> Will you kindly send me for use in this Department in its milk investigation any published reports or data you may have in regard to the work being done by your society?
>
> Any information you can give us will be of great assistance.

Replies were received from several of these associations, but none of them had anything to offer in the way of the informa-

tion asked for except the Holyoke and Boston Infant Hygiene Associations. From the first we received their first annual report published in 1914. This report is very interesting, and contains the names of the members of the association, the by-laws, amount of money spent on the work, and is descriptive in a general way. The detailed statement of the Boston association follows: —

Statement of Dr. J. Herbert Young.

The Milk and Baby Hygiene Association of Boston was organized in 1909. The purpose of the association, as stated in the first annual report, was —

1. To improve the milk supply.
2. To prevent sickness and reduce mortality among infants.
3. To increase the health and vitality of children and their mothers.

The methods to be used were —

1. Encouragement of breast feeding.
2. Distribution of clean milk.
3. Maintenance of a first-class milk modification laboratory.
4. Maintenance of milk stations in the neediest districts.
5. Instruction of high school girls, mothers and fathers in the care of children.
6. Supervision of the care and feeding of babies by skilled physicians and nurses at home and at the stations.
7. Conferences, lectures, exhibits and publications for milk consumers.
8. Co-operation with public health authorities.
9. Researches in bacteriology, biochemistry and sociology with reference to infant mortality.

The purpose of the association remains the same; our object is to keep well babies well. The methods used, while essentially the same, have been changed somewhat to meet existing circumstances. It has been our experience, as time goes on, that in our work as applied to the individual baby, *milk* assumes lesser and *hygiene* assumes greater importance. This does not mean, however, that the association does not continue to have an active interest in all phases of the milk question as applied to infants.

The field activities of the association are carried on from 12 milk stations. From these stations we cared for, in 1915, 4,800 babies. Of these babies about 50 per cent. were entirely breast fed, 30 per cent. partially breast fed and 20 per cent. entirely bottle fed.

Bids are annually requested for the milk sold at the milk stations. The milk at the present time is supplied by D. Whiting & Sons. This milk is sold to the mothers at cost. Milk modified at the laboratory of

D. Whiting & Sons, according to three formulæ recommended by the association, — certified milk, inspected whole milk and fat-free milk, — is provided. The modifications are made from milk certified by the Medical Milk Commission of Boston. The certified milk is certified by the Medical Milk Commission of Boston.

The whole milk and fat-free milk is of the grade known as inspected. This milk comes from dairies which show a score on the United States government score card between 75 and 80 points. The cows are annually subjected to the tuberculin test. The milk is pasteurized at a temperature of 145° for thirty minutes.

During the month of December, 1915, 494 quarts of modified milk, 57 quarts of certified milk, 5,414 quarts of inspected whole milk and 31 quarts of fat-free milk were sold at the 12 milk stations.

While we believe that the best food for a bottle-fed baby is the freshest, cleanest and purest cow's milk that it is possible to procure, we believe that the milk sold by our association, or any milk of equal grade, is a safe food for infants.

F. CITY OF BOSTON HEALTH DEPARTMENT.

Eugene R. Kelley, M.D., *Chairman, Milk Board, State Department of Health, State House, Boston.*

Dear Doctor: — In reply to your communication of the 9th instant, requesting an expression of my opinion on the present status of the milk situation, I would say that this Department has always kept in mind the sanitary aspect of this problem, never investigating the economic or political sides, and forbidding the employees of the Department from doing so.

Boston is expending large sums of money to improve the milk supply of this city, and the so-called metropolitan district of Boston has been reaping the benefit of this inspection without expense to those cities and towns in the district. This is manifestly unfair to Boston, but we do not complain, as under the present methods of inspection it cannot very well be avoided.

In my opinion the inspection of the production, handling and transportation of milk is largely an interstate problem, as about 92 per cent. of the milk sold in Boston comes from without the State, and should be supervised by the Federal authorities. As the government has refused to assume this responsibility, owing to lack of money to carry on the work, the duty should devolve on some central State authority, preferably the State Department of Health.

If the State Department were to take over this work it would do away with a great amount of duplication in inspections and issuances of permits. You are thoroughly conversant with the present law regarding the issuing of milk permits, so I will not go into that phase of the subject, except to say that if a central State authority had complete supervision

over these permits it would clarify the situation wonderfully. It would also help the producer, as he would have only one inspecting authority to satisfy, instead of three or four, as at present.

Local authorities should have complete control over the inspection and handling of milk within the limits of their respective cities and towns. The law, or statute requirements as to standards, etc., places that authority in their hands at present.

I believe in pasteurization of all milk, except certified milk, under proper supervision by the local authorities of the cities and towns where the milk is offered for sale.

Yours very truly,

F. X. Mahoney,
Health Commissioner.

G. MASSACHUSETTS STATE BOARD OF AGRICULTURE.

Massachusetts is peculiarly located in relation to other States of the New England group. With only two others smaller, and surrounded by them all, with New York on the west, it is the natural market for the group, as next to Rhode Island it is the most densely populated State in the United States.

Once Boston, which is now the great milk market of New England, produced its own milk supply. Then as the city grew, and demanded among other things fresh vegetables, the cows were pushed out to the near-by towns, and dairying went on until again the pressure for different kinds of agriculture was felt, and always dairying, which was considered a more extensive type of agriculture, depending on large pastures and lands to grow cheap forage, was pushed further from the central base, and Boston has had to draw its milk supply first from the 20-mile radius, then 50, then 100, and now much of the supply comes from over 200 miles. What is true of Boston has been true in a measure of many of the smaller cities; but many of these latter, owing to their proximity to the farm lands, have done much to encourage the dairy industry near by, and are, therefore, supplied with a better grade of milk than is usually sold in the Boston market, where now a more discriminating public is demanding that its milk supply be drawn from sources near the consumption line, and under conditions upon which it desires to impose restrictions which are bound to increase the cost of production, as well as that of transportation and distribution.

Massachusetts agriculture has seen great changes in the past one hundred years, chiefly owing to the severe competition of States more favored than we are by climate, soil or transportation facilities for the production and distribution of some particular crop; but in spite of the loss of some crops and a great reduction in dairying, the State has advanced steadily in the value of its agricultural products since 1870, as the following figures will show: —

1879,	$24,160,881
1889,	28,072,500
1899,	42,298,274
1909,	60,000,000

Market gardening, fruit growing and the production of special greenhouse crops have in many instances taken the place of dairying on our farms, and particularly so near the cities, where it has been possible to obtain manure from city stables to conduct these operations.

With the very acute fertilizer situation our farmers' attention is more forcibly drawn to the general problem of keeping up soil fertility, and were this situation to continue for long, undoubtedly it would have a very great effect in restocking with dairy animals many of the farms of the State. That there is a desire on the part of many farmers to put cattle back on the farm is apparent, and there is a decided feeling in many sections that the cow is a necessity in our agriculture; that milk should be treated as a by-product; that we should raise more pure-bred stock in this State; and that all of our dairymen should raise their own stock and not depend upon those shipped here.

With our great resources in undeveloped land, salt and fresh marshes for growing hay, upland pastures now growing up to brush, and much valley land still unproductive, we certainly have a chance to produce all the milk, cream and butter that we consume. That we shall produce it some time is apparent, but with present conditions as they are, with our best markets flooded with milk produced in more natural dairy sections than ours, and hauled to these markets as cheaply as ours, Massachusetts' problem is one of producing a superior article which will be called for in our markets in preference to any other.

That the dairy problem is no new one to our people is apparent from the following, taken from the report of the secretary of the State Board of Agriculture for 1884: —

> The production of milk to supply our towns and cities is a branch of husbandry that in late years has not been satisfactory; the farmers have allowed shrewd contractors to control the supply and sale of milk, and have accepted prices lower than the cost of production.

In a way it is to the credit of our farmers that they have gone out of the dairy business rather than produce an article for which they did not receive a profit; but the most vital question is a readjustment of our agriculture, and a readjustment in which the dairy cow will play a prominent part. Diversified agriculture is bound to become more common with the exception of very favorable localities, in which rotation of crops, together with animal husbandry, will be practiced, and a business built upon quality and freshness of our products will take the place of the now long-distance shipments which are so common in our markets.

H. MASSACHUSETTS STATE DEPARTMENT OF ANIMAL INDUSTRY.

State House, Boston, Sept. 15, 1915.

Dr. Eugene R. Kelley, *Chairman of Milk Board, State Department of Health.*

Dear Sir: — Your letter of September 9 at hand, and in reply will furnish you with what information I can on the different subjects mentioned.

On account of the prevalence of foot-and-mouth disease this past season the annual inspection of animals and premises by the local inspectors of animals throughout the State was abandoned. This animal inspection is generally recorded during the early spring months, when the animals are all in the barns and can be more conveniently examined, and in order that disease which may have been influenced by the housing of the animals during the winter months may be recognized. On account of the danger of spreading foot-and-mouth disease by the medium of the local inspectors of animals going from farm to farm, and also on account of the apprehension of cattle owners of this danger of spread of the disease, we decided that no inspection should take place this year.

The next inspection will undoubtedly be ordered some time during the coming winter, and at the end of that inspection a much better general opinion of conditions of animals and premises can be rendered than at the present time.

If, upon examination of the animals on a certain premises by an inspector, he has reason to suspect the presence of any contagious disease, he is ordered to quarantine such animal or animals, and send duplicate copy of such quarantine to this office.

I am enclosing to you a blank form used by the local inspector of animals at the time of their examination, in order that you may see the information they are expected to return to us. A copy of their report is left with the owner of the animal, another one retained by the inspector, and the full record sent to this office. At the time a copy of this record is left with the owner of the premises, such recommendations for improved conditions, if any, as are necessary in the opinion of the inspector, are brought to the attention of the owner by the inspector, and the owner is requested to make such improvements. A later visit is made by the local inspector, at which time, if conditions are found to be decidedly improved, the report submitted to this Department above referred to credits the owner with the conditions found on the second visit, and in most cases we find that the owners carry out the recommendations made by the inspectors.

As a result, many of the cases that under a former plan would have been called to the attention of the district agents of our department are satisfactorily disposed of locally, but if not so disposed of our district

agent is sent to the premises, and this Department's supervision is directly given to such premises, and frequent visits made until they are placed in a satisfactory condition.

All cattle over six months of age coming into Massachusetts from any point without the State, if not intended for immediate slaughter, are according to law tuberculin tested by an agent of this Department, unless accompanied by a certificate of test made by a man approved by the officials of the State wherein the shipment originates. All animals reacting to this test are destroyed.

For the Year ending Dec. 1, 1914.

Number of cattle tuberculin tested by agents of this Department or approved veterinarians outside of the State were	23,645
Released at Brighton,	17,485
Released at other points,	5,472
Released for slaughter,	2
Condemned at Brighton,	587
Condemned at other points,	86
Permit-to-kill warrant issued,	13

The above figures relate only to cattle brought into Massachusetts from without the State.

Of the 17,411 tested at the quarantine station in Brighton 587, or $3\frac{1}{3}$ per cent., reacted to the tuberculin test, and only one of such reactors failed to show lesions of tuberculosis on post-mortem examination, which is made in every case.

The following figures show the number of neat cattle quarantined by local inspectors of animals within the State, for which number warrants were issued by this Department, and disposition made of the animals: —

Massachusetts Cattle.

Total number of cattle quarantined or reported for examination during the year,	2,259
Number released,	288
Number condemned, killed and paid for,	880
Number condemned and killed, in process of settlement,	141
Number permit to kill, paid for,	63
Number permit to kill, no award,	174
Number died in quarantine, no award,	36

Cattle from without the State.

Number released,	12
Number condemned and killed, no award,	654
Number condemned and killed, no lesions found, paid for,	6
Number in process of settlement,	5

In addition to the 2,259 head of cattle disposed of as above, 133 cattle and 27 swine have been reported by butchers, renderers and boards of health as having been found tuberculous at time of slaughter, all of which were rendered.

I quote you section 31, chapter 90, Revised Laws, as amended, which restricts the use of tuberculin as a diagnostic agent: —

> Tuberculin as a diagnostic agent for the detection of tuberculosis in domestic animals shall be used only upon cattle brought into the commonwealth and upon cattle at Brighton, Watertown, and Somerville; but it may be used as such diagnostic agent on any animal in any other part of the commonwealth, with the consent in writing of the owner or person in possession thereof, and upon animals which have been condemned as tuberculous upon physical examination by a competent veterinary surgeon. Such tests by the use of tuberculin shall be made without charge to citizens of the commonwealth, and in all other cases the expense of such tests shall be paid by the owners of such animals or by the person in possession thereof.

The activities of the local inspectors of animals are not limited to their annual cattle inspection. On finding an animal which to them seems to be probably diseased, they quarantine the same, and return a duplicate to this office. A warrant or killing order is then made out, and one of our district agents, or an outside veterinarian who acts as our agent, is charged with the execution of the warrant. If, on physical examination the animal is found to be diseased, it is condemned and killed, and report made to this office of the lesions found on post-mortem examination.

Following the disposal of a case of tuberculosis, the owner is required to disinfect the premises according to our instructions, and his claim for reimbursement for the death of the animal is not paid until report is on file in this office that the disinfection has been satisfactorily completed.

I am about to institute the practice of careful physical examination of all the animals in the herd from which an animal afflicted with tuberculosis has been condemned by this Department. In my opinion this will bring to notice a no inconsiderable number of diseased animals which otherwise might have escaped notice for a greater or less period, during which time they were acting as spreaders of the disease.

The percentage of Massachusetts cattle tested with tuberculin is necessarily small, and it is impossible to get at the correct statistics. This Department tests Massachusetts cattle with tuberculin only upon voluntary request of the owner, and private tests which are made are not in very many cases reported to this office, so that no means are at hand for obtaining information as regards the percentage of the State's cattle which are tuberculin tested.

Whether or not a tuberculin test should be compulsory is a large question, and open to a great deal of argument *pro* and *con*. Compulsory tuberculin test was inaugurated in this State some twenty years ago, but it was not carried very far before the farmers rose *en masse* against it. Tuberculosis was then so rampant among the cattle of this State that in many instances as high as 30 to 50 per cent. of the cattle were destroyed as a result of the tuberculin test, and the carcasses became a total loss.

In my opinion there is a gradual improvement from year to year in the percentage of cases of tuberculosis among our cattle, and with what improvements we make in the control of this disease I think the general situation is found to gradually become better.

On the appearance of foot-and-mouth disease in this State last November the great market for milch cows, viz., Brighton Stock Yards, was immediately closed, and remained closed until Sept. 1, 1915, when modification of the quarantine was allowed, so that there could be received at these premises cattle from the States of Massachusetts, Maine, Vermont and New Hampshire. Cattle from all other States in the Union are prohibited from entering the Brighton Stock Yards unless intended for immediate slaughter, and all cattle received from any other sections of the country than those States mentioned are obliged to remain in quarantine at the point of arrival until released by an agent of this Department, and at the present time this limit of quarantine is fifteen days, so that in case the animals have picked up this infection en route, sufficient time will elapse while in quarantine for them to show clinical symptoms, and the disease will therefore be confined to those premises. No cattle are received anywhere in Massachusetts from any point other than what is designated as "free area" by the United States Department of Agriculture. All premises on which foot-and-mouth disease existed during the recent epidemic are still under quarantine, and animals go to and from such premises only on permit of this Department.

Regarding the health of cattle in different sections of the State, a larger number of cases of disease are found in the middle and eastern sections. Very little contagious disease of any kind is found in the Cape district, and in that portion of the State west of the Connecticut River.

As you asked for a personal opinion regarding physical examination of animals, I would say that it is my belief that a more careful and more frequent physical examination would certainly tend toward an improvement in the health conditions as viewed from the standpoint of the products of the animal industry, whether that product be milk or meat.

Very truly yours,

LESTER H. HOWARD,
Commissioner.

I. CATTLE BREEDERS' ASSOCIATIONS.

Appended is a list of the replies from several cattle breeders' associations in response to request for information as to their opinion on the question of selling milk on a basis of its food value.

Mr. Williams attended a meeting of the New England Holstein Friesian Breeders' Association, and asked for an opinion on the matter of selling milk on a basis of its food value. The

members of the association would not give a frank opinion, but two or three members said that the association had always stood for clean, pure milk. Mr. Williams was led to believe that they were opposed to any system whereby milk would be sold on a basis of its food value. Several of the members made claims that Holstein milk was a better milk for infants or invalids than any other, and that it was the best substitute for mother's milk that could be found. Professor Hills in an address at the meeting said that he had carried on a great number of experiments, and had come to the conclusion that Holstein milk was the nearest to the present milk for infant feeding, but was no better than Jersey or Guernsey milk that was reduced to the same amount of fat, solids, sugar, etc. Professor Hills said that his experiments had been carried on on a large number of baby pigs.

No answer has been received from the American Holstein Friesian Association in response to our letter, as the secretary could not say how they felt in the matter, but he said he would take it up at some future meeting. All of the other associations that have answered have expressed their approval of the idea of selling milk on a basis of its food value.

As far as the Jersey breed of cattle is concerned, nothing would please us better than to see milk universally sold in accordance with its value as food. (American Jersey Cattle Club, R. M. Gow, Secretary.)

There is no question about the desirability of selling milk on the basis of its food value. Brown Swiss Breeders are in favor of a quality test on milk. (Brown Swiss Breeders' Association, H. C. Taylor, Secretary.)

The question has never been discussed by the Ayrshire Breeders' Association in relation to selling milk on its food value. My personal opinion is that milk should be sold on the food value it contains. (Ayrshire Breeders' Association, C. M. Winslow, Secretary.)

I am personally a great believer in the selling of milk and dairy products according to their value as food. Why should not the same be done as with other commodities? (American Guernsey Cattle Club, W. H. Caldwell, Secretary.)

I was always of the belief that all dairy products should be sold as nearly as possible on their basis of food value. (Red Polled Cattle Club, H. A. Martin, Secretary.)

PART III. FACTS OF PRODUCTION, PROCESSING AND MARKETING.

A. SUMMARY OF MILK BOARD'S OWN DAIRY INSPECTIONS.

The Milk Board visited various sections of Massachusetts, Maine, New Hampshire, Vermont, Connecticut and New York and the Province of Quebec in their investigation of the milk problem as it pertains to the State of Massachusetts. More than 300 dairies were investigated, and although this number represents approximately only 2 per cent. of the total number of dairies within the State, their location and type make them reasonably representative of the whole. The committee started its work in the Berkshire section of the State in April, 1915. In May 33 dairies were investigated in the following towns: Truro, North Truro, Orleans, East Orleans, Eastham, Barnstable and Sandwich. There were a total of 146 cows kept on these dairies, producing approximately 1,429 quarts of milk per day. The farms were on the average neat and clean. Many of the barns were old but kept in reasonably good condition. Only in one or two instances were they of a low standard. Cooling and icing were done in a fairly satisfactory manner. Several farmers state that there is no demand for winter milk, and are considering the keeping of cows only for the summer trade. The average price for milk at wholesale is 6 to 7 cents per quart, and at retail, 10 to 12 cents per quart. Some dairies sell at the door for from 7 to 9 cents per quart. Mr. P., a small producer, wholesales at 6 cents per quart, and says that "there is no money in the business." Another dairyman who retails his product says that the business pays only when milk sells at 10 cents. There were four herds in this section tuberculin tested. Dairies were subject to local and State inspection, and no complaints were heard regarding it. Fifteen dairies in Truro, supplying milk to Provincetown, were inspected and scored, the old form of score card being used. For methods they averaged

73 of the perfect score and for cleanliness, 72. Two instances were noted where former inspection by the State Department of Health had been of service. A man who owned the dairy which gave the highest score stated that the conditions found were due to suggestions made by the inspector of the Department. Another who had been annoyed with moisture collecting upon the ceiling and falling down said that upon advice of the inspector of the State Department of Health the condition had been removed. Conditions of the dairies in this part of the State are rather different than those elsewhere. There are fewer cows, and milk is as a rule delivered to consumers by the owner of the dairy immediately after milking, and very frequently without cooling.

The district visited about Lynn included this city and Saugus, Melrose, Lynnfield, Peabody and Salem. Thirteen dairies were visited. A total of 462 cows were kept. The conditions in general were good. Poor drainage conditions were noted in two, and a few did not have separate milk rooms. On several dairies only a few cows were kept principally for the purpose of producing fertilizer. Such places were engaged in market gardening, the dairy end being more or less a side line. On one of the places the cattle were regularly inspected by veterinaries, and the men employed subjected to physical examination by physicians. Milk retails for from 7 to 12 cents per quart, and wholesales at 45 to 50 cents per can in winter and from 42 to 43 cents in summer. Mr. B., who has 18 cows, says there is no money in the business at these prices. Mr. S., having 50 cows and selling milk at 8 cents retail, says the milk business is not so profitable as it used to be because grain and cows cost so much. In Methuen, Bedford and Concord 9 dairies were visited, with a total of 375 cows kept. The conditions found were generally satisfactory. Milk from these dairies retails for from 8 to 12 cents per quart. Mr. B., producing 160 quarts daily, all of which he retails at 8 cents per quart, said that the milk should bring 9 cents per quart to make the business a paying proposition. All these dairies and those included in the Lynn district are subject to local and State inspection. There appears to be no objection to such inspection; no complaints were made. Mr. H., who keeps 50 head of cattle and

produces 300 quarts of milk daily, said that proper inspection would be a good thing if the inspector understood the farmer's problem. Representatives of the committee visited the district about Fitchburg, which included, beside the city, the towns of Westminster and Winchendon. Eight dairies were visited upon which were kept a total of 205 cows, producing approximately 1,509 quarts of milk daily. One of the dairies produced cream and wholesaled in the city of Fitchburg. All the dairies visited presented very satisfactory conditions. They were subject to frequent local inspection, which was based upon education rather than coercion. Commendable conditions were noted on dairies in Winchendon. Only two dairies wholesaled their milk and one wholesaled cream. The prices received by these dairies were 40 cents per can for milk and 50 cents per quart for cream. Milk retails in Fitchburg for from 8 to 12 cents per quart, while in Winchendon the maximum is 8 cents per quart. Mr. M. of Winchendon, whose methods and equipment gave an excellent score, 93, thinks that 10 cents per quart would be a fair price.

In the Berkshire district which included Richmond, West Stockbridge, Great Barrington, Egremont, New York State, Stockbridge, Pittsfield and Cheshire, 15 dairies were visited, also one creamery keeping 333 head of cattle and 33 young stock. In many of the farms visited conditions were found to be fairly good. Some in addition to dairy farming were engaged in various side lines, such as poultry, pork raising and summer boarders. Milk from this section is shipped into Pittsfield, Mass., and New York. Mr. S., who operates a 100-acre farm, retails the milk at 8 cents per quart. He says that were it not for the fact that he and his wife do all the work he could not stay in the business. One of the troubles he says has been multiplicity of inspection. A Mr. C., operating a 200-acre farm, says that milk should bring 5 cents per quart at the farm in order to pay. Butter produced in this section brings at retail 35 to 40 cents per pound. Mr. M., who has a 275-acre farm and is engaged in this business, states that butter could not be produced for less than the prices given and allow a living margin. The dairies are subject to local inspection. Inspectors also come in from Pittsfield and New York to dairies supplying milk to these places.

The committee visited 80 dairies in the Deerfield valley, including the following towns: Ashfield, Buckland, Conway, Shelburne, Charlemont, Heath and Whitingham, Vt.

The dairies were found to be in a very poor condition. On a total score, 10 per cent. scored below 40 and only 1 per cent. above 70. The Milk Inspection Association had recommended that permits be refused to any dairies scoring below 50. Nearly all the dairies use ice for cooling. The milk is kept in 40-quart cans, and is collected every day, or every other day in some cases, and delivered to the railroad depot, where it is kept without being iced until placed on the train. Some of the farmers are obliged to cart their milk some distance and leave it on the platform in the sun until the collector calls for it. A number of Polish people have bought up old farms in this region and are gradually improving them. One of these, for example, presented dirty walls and floors, with manure piled up to the windows. This place scored 48.7, but the use of ice in milk house brought up the score. On another place presenting dirty conditions the woman who was interviewed stated that she knew the stable was in poor condition, but the price given for milk was insufficient to compensate for making any improvements. She also stated that the Pole who collected the milk was in the habit of measuring it by means of a stick which he wiped sometimes on a cloth, sometimes on his overalls and sometimes on the grass. The average price paid the farmers is $1.55 per 100 pounds, which is undoubtedly less than the cost of production, and out of this is deducted the cost of transportation. One farmer stated that the reason for the low price of milk was due to the inability of the farmers to hold together. Very few of the farmers keep more than 10 cows. They keep only a sufficient number to enable them to keep up the farm, the principal product being manure and the by-product being milk. Inquiries relative to any systematic inspection being made met with negative replies. The only inspection is that casually done by the man representing the milk contractor at the time he makes his visits to solicit milk from the farmers. The character of some of these dairies warrants the statement that the contracting company is willing to take milk from any dairy, no matter what condition it is in. Dairies were visited by the committee in the towns of North

Charlestown, Claremont, Greenville, Mason, all in New Hampshire, and Wethersfield, Vt. Thirteen dairies were inspected on which were kept a total of 150 cows, producing approximately 131 cans of milk per day which was shipped into the State of Massachusetts. A few places presented fairly good conditions, while in others various objectionable conditions prevailed, such as poor barns, lack of proper milk rooms or suitable places to handle milk, poor methods of cooling and low standard of cleanliness. Milk is wholesaled at 25 to 32½ cents per can. A Mr. M., producing 8 cans of milk per day, says that the laws discourage milk production.

Seven dairies at Wethersfield, Vt., were visited, where a total of 149 cows were kept, producing 550 quarts of milk per day, all of which was shipped into Boston, Mass., to a milk contractor. Conditions on each dairy were distinctly bad. The place in which the cows were kept was unfit because of filthy and wretched drainage, poor light and ventilation and general filthy conditions. Some of the most filthy conditions of all were found on the milk collector's farm, this man being employed by the contracting company to collect the milk from the farmers and ship it to Boston. Farmers complained of delay in collecting and shipping the milk, one farmer stating that the milk was thirty-six hours old before it was shipped from Claremont. The price paid the farmers for milk ranged from 28 to 33 cents per can. One farmer preferred to sell his milk to a local creamery. The wife of a dairyman, in his absence, stated that her husband did not consider there was any money in the business at the price they were getting. Others were going out of business because of the low price received. The committee were of the opinion that milk from this region should not be permitted to enter Massachusetts or any other State as conditions now exist on the farms.

The committee visited 27 dairies in the counties of Androscoggin, Cumberland, Kennebec, Lincoln, Sagadahoc and Waldo, Me.; also visited the plants of the milk contractors in this region from which milk is shipped into Massachusetts, the principal one of which is the Turner Center Dairying Association. Of the 27 dairies visited, 22 sold to this association, 4 to two Massachusetts contractors and 1 to the Bangor Creamery. The

dairies supplying the Turner Center Dairying Association were found to be in the best condition, while those supplying the Massachusetts contractors presented nasty conditions; horse manure was used in gutter, and milk was found cooled in tub of water near pump in hot weather and was not cooled at all in cold weather. The pasteurizing plants were found to be in a very good sanitary condition, and conducted on the whole in a satisfactory manner. The plants visited were located at Auburn, Wiscasset, West Benton and Unity. The pasteurizing plant of one of the Massachusetts contractors at Unity was in an extremely dirty condition. Pasteurization in this plant is supposed to be carried on at a temperature between 160 to 170, and the cream is held for thirty minutes, while skimmed milk is not held. The temperature at the time of visit registered 172.

The Turner Center Dairying Association has the total output of between 4,200 and 4,300 farms situated in Maine. Of this amount, 75 per cent. is sold in Massachusetts. Very little is sold at retail in Massachusetts except in the city of Lawrence. Mr. Bradford, manager of this association, believes that payment on a butter-fat basis has a tendency to make farmers produce milk very high in butter fat. The price of butter fat is fixed from time to time. They also purchase by hundredweight of milk, and give a bonus of 1 cent per pound of butter fat for milk from tuberculin tested herds. Mr. Bradford thought the average retail price for bottled milk in the larger cities of Maine was 8 cents per quart, while in smaller places it was as low as 6 cents per quart. The average price to the farmer in the State of Maine, he presumed, was $3\frac{1}{2}$ to $4\frac{1}{2}$ cents per quart.

A farmer selling to the Turner Center Dairying Association stated that he makes a profit of at least $250 per year from milk alone from 10 cows. Nearly all dairymen interviewed were of the opinion that they did not lose any money on their milk. One criticized the method of selling, as he was obliged to take the word of the Dairy Association as to the weight and fat contents of his milk.

All the product of the Turner Center Dairying Association is pasteurized. Pasteurization is done at creameries in Maine.

The milk is subsequently bottled in Boston at the point of shipment. Milk received at one of the plants of a Massachusetts contractor at Etna, Me., was not pasteurized. It was received at the station, placed in cans in ice water, and shipped on the train the following morning, arriving in Boston at 4 or 5 P.M.

The committee visited the Province of Quebec to look into dairies shipping milk and cream into Massachusetts by way of Newport, Vt. The business of shipping milk at this point has gradually grown during the few years it has been in operation until at the present time an average of 250 40-quart cans or jugs of milk and cream are sent out every night. In addition to this section it was learned that there were three other distinct sections in the Province of Quebec from which milk and cream were sent into Boston, viz., by the Passumpsic Division of the Boston & Maine Railroad; a triangular area with apex at St. Albans, Vt.; and a branch road north of the Grand Trunk line, connecting with the main line running from Montreal to Portland, Me. It appeared to the committee that the various milk contractors were trying to keep the milk and cream during transit in as good condition as when received. Two methods of cooling were in operation during transportation, — the iced car and blanketing. Inspection of one of the contractor's creameries located at Newport, Vt., showed that the conditions did not compare with those existing in the same company's plant in Massachusetts. The price paid at Newport station for cream is 32 cents per pound of butter fat, and for milk, $1.60 per 100 pounds of milk. The prices are based upon a sliding scale from month to month. Twenty-seven dairies were inspected in this region, 13 of which shipped their milk into Massachusetts. The sanitary conditions on the various farms compared very favorably with conditions found in dairies located in New Hampshire, and were very much better than those noted in the dairies visited in Vermont. At the time of visit they were being inspected by a representative from the United States Department of Agriculture. Through his efforts many improvements were being made on the different farms. A good many of the farmers in this region are engaged in raising young stock for beef, and make use of the skimmed milk

for this purpose. One farmer stated that he did not consider there was much money in selling cream, but the skimmed milk disposed of in this way helped out. The dairies in the vicinity of Lyndonville, Vt., supplying the Lyndonville Creameries Association, were investigated in company with the board of health of the city of Newton. These dairies were found to be in a most unsanitary condition, the score for cleanliness of stable being very low. In some instances the separators were placed directly behind the cows in the open barn. It was also a common practice to have privies in the stables. In many instances the milk was kept twenty-four hours in a tub of water in the stable, the covers of the cans being generally partly removed.

From the foregoing summary we may conclude (1) that although the dairies in Massachusetts as represented by those visited, except dairies in the Deerfield valley, are reasonably satisfactory, the conditions vary somewhat in different sections, and (2) that dairies in New Hampshire, Vermont, Maine and the Province of Quebec do not reach the same standards as those in Massachusetts. A few deductions showing the differences follow: —

Dairies in Cape Cod section, while having barns that are old and methods and equipment not as modern as are found in other sections, are nevertheless well kept, neat and clean.

Dairies about Lynn and Methuen have somewhat better conditions as to structure and equipment. In this section are examples of the best conducted and equipped dairies. One of them requires regular inspection of the cattle by veterinaries, also medical inspection of the men employed.

Dairies about Fitchburg and Winchendon presented commendable conditions. Dairies in Winchendon, examples of the average old farm, have been brought up to an excellent sanitary condition, with good separate milk rooms, proper cooling facilities and equipment for the sterilization of milk utensils, etc., through a local system of educational inspection.

Dairies in the Berkshire district are not as well kept as in other sections. A number of them engage in other lines, such as raising pork, poultry, keeping summer boarders, etc., so that the dairy end failed to receive the proper attention.

Dairies in the Deerfield valley presented filthy conditions. The farms are run down and are being bought up by Polish people who are gradually improving them. Only a few cows are kept on each of the different farms, principally for fertilizer, the milk apparently being a by-product.

Dairies at Wethersfield and Lyndonville, Vt., presented the most filthy conditions of any visited out of Massachusetts. Drainage conditions were such as to render the places unfit for the housing of cattle. Facilities for the handling of milk were entirely inadequate. Nasty methods of cooling the milk were used.

Dairies in Maine shipping to Massachusetts contractors were in much worse condition than those supplying the local dairying association. Horse manure was used in the gutters and careless and nasty methods of cooling the milk prevailed, such as cooling in the tub from which cattle drank.

Dairies in New Hampshire have poor cow barns, lack of suitable milk rooms, crude methods of cooling the milk, and rather low standard of cleanliness.

Dairies in the Province of Quebec presented fair conditions. Improvements in some were being made. They lacked suitable milk rooms and proper facilities for cooling. Cows were housed in the cellars of the barns because of the extreme cold in winter.

A summary of the scores of the dairies inspected on these trips is given in the following table: —

Summary of Dairy Scores made on Inspection Trips.

Cleanliness of Stable.

Scores.	15 Cape Dairies.		11 of Hood's Dairies, Pittsfield, New Hampshire.		26 of Childs & Barrows' Dairies in New Hampshire and Vermont.		80 of Hood's Dairies in Deerfield Valley.		27 Dairies in Maine.		80 Dairies in Connecticut Valley.		22 Dairies in Berkshire County.		44 Dairies near Lyndonville, Vermont.	
	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.
0,	–	–	–	–	19.2	0.0	27.3	0.0	–	–	–	–	–	–	50.0	0.0
1,	6.7	1.9	–	–	–	–	21.3	1.3	18.5	0.7	10.0	1.3	4.6	1.0	2.3	1.5
2,	–	–	9.1	2.5	19.2	2.1	23.8	2.3	29.6	2.6	11.3	2.2	27.2	2.2	20.5	2.2
3,	26.6	3.6	–	–	15.4	3.2	18.8	3.3	33.4	3.3	65.0	3.1	45.6	3.2	13.7	3.3
4,	40.0	4.5	81.8	4.2	11.5	4.3	5.0	4.1	18.5	4.2	12.5	4.3	22.6	4.6	6.8	4.1
5,	20.0	5.2	9.1	5.0	23.2	5.0	3.8	5.1	–	–	1.2	5.0	–	–	–	–
6,	6.7	6.0	–	–	11.5	6.0	–	–	–	–	–	–	–	–	6.7	6.0
Average,	100.0	4.4	100.0	4.1	100.0	3.2	100.0	2.0	100.0	2.8	100.0	3.1	100.0	3.1	100.0	1.6

Summary of Dairy Scores made on Inspection Trips — Continued.

Milk House.

Scores.	15 Cape Dairies.		11 of Hood's Dairies, Pittsfield, New Hampshire.		26 of Childs & Barrows' Dairies in New Hampshire and Vermont.		80 of Hood's Dairies in Deerfield Valley.		27 Dairies in Maine.		80 Dairies in Connecticut Valley.		22 Dairies in Berkshire County.		44 Dairies near Lyndonville, Vermont.	
	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.
0,	20.0	0.0	18.2	0.0	57.7	0.0	21.2	0.0	55.5	0.0	37.5	0.0	22.6	0.0	81.8	0.0
1,	–	–	–	–	11.5	1.4	32.5	1.4	14.8	1.2	25.0	1.2	22.7	1.3	9.2	1.0
2,	6.7	2.3	9.1	2.3	27.0	2.1	45.0	2.1	26.0	2.3	21.2	2.0	36.4	2.3	4.5	2.0
3,	6.7	3.3	72.7	3.0	3.8	3.0	–	–	3.7	3.3	8.8	3.1	4.6	3.0	4.5	3.7
4,	53.3	4.2	–	–	–	–	1.3	4.0	–	–	6.2	4.0	9.1	4.2	–	–
5,	13.3	5.0	–	–	–	–	–	–	–	–	1.3	5.0	4.6	5.2	–	–
Average,	100.0	2.7	100.0	2.7	100.0	0.8	100.0	1.4	100.0	3.3	100.0	1.4	100.0	1.9	100.0	0.3

Equipment.

0– 4,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4– 8,	–	–	–	–	–	–	–	–	3.7	7.4	–	–	–	–	2.3	7.0
8–12,	–	–	–	–	–	–	6.3	10.1	3.6	9.0	–	–	–	–	–	–

12–16, ...	6.7	15.4	–	–	3.8	15.5	32.5	14.0	22.5	14.5	37.5	14.0	22.7	14.6	40.8	14.9
16–20, ...	20.0	18.8	27.3	18.7	57.7	18.5	48.7	17.0	48.1	17.6	42.5	17.0	40.9	17.8	47.8	17.0
20–24, ...	53.3	22.6	36.4	22.1	38.5	21.2	8.8	21.0	18.5	22.2	10.0	22.0	22.7	21.7	4.5	21.0
24–28, ...	13.3	25.7	27.3	25.7	–	–	2.5	24.0	3.6	26.6	10.0	25.0	4.6	24.1	–	–
28–32, ...	6.7	29.0	9.0	28.1	–	–	1.2	32.0	–	–	–	–	–	–	–	–
32–36, ...	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.3	32.7
36–40, ...	–	–	–	–	–	–	–	–	–	–	–	–	9.1	36.7	2.3	38.0
Average, . .	100.0	21.6	100.0	22.5	100.0	19.8	100.0	16.6	100.0	17.4	100.0	17.2	100.0	20.0	100.0	14.5

Methods.

0– 6, ...	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.3	6.0
6–12, ...	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
12–18, ...	–	–	–	–	–	–	–	–	3.7	13.6	–	–	–	–	–	–
18–24, ...	–	–	–	–	–	–	2.5	21.0	7.4	22.0	–	–	–	–	6.7	23.1
24–30, ...	–	–	9.1	29.7	3.8	29.4	13.7	27.0	22.5	25.9	17.5	27.0	50.0	26.5	13.6	27.5
30–36, ...	20.0	33.6	28.3	34.1	46.3	33.4	37.5	33.0	7.4	33.2	52.5	33.0	36.3	32.9	52.4	32.6
36–42, ...	13.3	36.6	62.6	37.9	30.8	39.1	26.3	39.0	37.0	38.2	22.5	37.0	4.6	40.5	20.5	38.0
42–48, ...	33.4	44.7	–	–	11.5	44.0	17.5	44.0	22.0	44.1	6.2	43.0	9.1	43.8	–	–
48–54, ...	20.0	49.3	–	–	7.6	48.5	2.5	52.0	–	–	1.3	49.0	–	–	4.5	50.2
54–60, ...	13.3	54.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Average, . .	100.0	43.6	100.0	36.2	100.0	37.4	100.0	35.0	100.0	34.4	100.0	34.0	100.0	31.4	100.0	32.3

Summary of Dairy Scores made on Inspection Trips — Concluded.

TOTAL SCORE.

SCORES.	15 CAPE DAIRIES.		11 OF HOOD'S DAIRIES, PITTSFIELD, NEW HAMPSHIRE.		26 OF CHILDS & BARROWS' DAIRIES IN NEW HAMPSHIRE AND VERMONT.		80 OF HOOD'S DAIRIES IN DEERFIELD VALLEY.		27 DAIRIES IN MAINE.		80 DAIRIES IN CONNECTICUT VALLEY.		22 DAIRIES IN BERKSHIRE COUNTY.		44 DAIRIES NEAR LYNDONVILLE, VERMONT.	
	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.	Per Cent. of Dairies.	Average Score.
0–10,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10–20,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
20–30,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.3	13.0
30–40,	–	–	–	–	–	–	–	–	7.4	25.2	–	–	–	–	–	–
40–50,	6.7	48.9	9.0	48.6	19.2	49.6	8.8	36.0	7.4	39.4	2.5	38.0	–	–	9.2	37.6
50–60,	20.0	55.9	45.5	56.7	50.0	54.8	27.5	46.0	22.2	43.9	45.0	48.0	50.0	42.9	40.8	46.1
60–70,	26.6	65.3	45.5	63.1	27.0	63.5	38.8	54.0	33.3	54.5	37.5	53.0	31.7	53.3	40.8	52.8
70–80,	40.0	72.8	–	–	3.8	70.0	23.7	63.0	26.0	64.1	12.5	65.0	9.1	63.5	2.3	61.0
80–90,	6.7	84.0	–	–	–	–	–	–	3.7	70.0	2.5	73.0	4.6	71.1	–	–
90–100,	–	–	–	–	–	–	1.2	87.0	–	–	–	–	4.6	82.2	4.6	85.7
Average,	100.0	66.4	100.0	58.9	100.0	56.8	100.0	52.5	100.0	52.0	100.0	51.0	100.0	50.7	100.0	49.5

B. COMPILATION OF MILK CONTRACTORS' STATEMENTS.

A circular letter of inquiry was sent to the following milk dealers doing business in Massachusetts: —

Alden Brothers, 1171 Tremont Street, Boston, Mass.
C. Brigham Company, 158 Massachusetts Avenue, Cambridge, Mass.
W. D. Cowls & Son, North Amherst, Mass.
Deerfoot Farm, 9 Bosworth Street, Boston, Mass.
Elm Farm Milk Company, 19 Wales Place, Dorchester, Mass.
W. A. Graustein, President, Boston Condensed Milk Company, 134 Cass Street (?), 484 Rutherford Avenue, Charlestown.
H. P. Hood & Sons, 494 Rutherford Avenue, Boston, Mass.
Manley Dairy Company, Brockton, Mass.
A. D. Perry, Worcester, Mass.
Plymouth Creamery, 268 State Street, Boston, Mass.
H. H. Prentice, Pittsfield, Mass.
J. B. Prescott, Bedford, Mass.
Tait Brothers, Springfield, Mass.
Turner Center Company, 63–69 Endicott Street, Boston, Mass.
D. Whiting & Sons, 590 Rutherford Avenue, Boston, Mass.

The letter requested information upon the following points of the business: —

1. The quantity of milk and cream sold.
2. Name of Massachusetts cities and towns in which milk is sold.
3. Approximate proportion produced in individual New England States, New York and Canada.
4. Details as to pasteurization.
5 and 6. Details as to dealers' system of dairy inspection.
7, 8 and 9. Requests for contractors' opinions on certain aspects of the milk business.

The answers to these last three questions have been discussed elsewhere.

A few weeks after first sending out the circular letter it was learned by accident that one of the contractors had never received this letter, or that it was never referred to the responsible officer of the firm. A second letter was then sent by registered mail to those who had not previously replied. This brought several prompt responses.

Up to November 30 the following dealers have replied: —

1. Alden Bros., Boston, Mass.
2. C. Brigham Company, Cambridge, Mass.
3. Deerfoot Farm Dairy, Boston, Mass.

4. A. D. Perry, Worcester, Mass.
5. Plymouth Creamery, Boston, Mass.
6. H. H. Prentice, Pittsfield, Mass.
7. J. B. Prescott, Bedford, Mass.
8. Tait Bros., Springfield, Mass.
9. Turner Center Dairying Association, Auburn, Me.
10. D. Whiting & Sons, Boston, Mass.
11. H. P. Hood & Sons, Boston, Mass.

No replies have been received from the following: —

1. W. D. Cowls, North Amherst, Mass.
2. Elm Farm Milk Company, Boston, Mass.
3. W. A. Graustein, President, Boston Condensed Milk Company, Charlestown, Mass.
4. Manley Dairy Company, Brockton, Mass.

The following is a summary of the replies received: —

Question 1. — Approximately how much milk and cream per annum do you sell? Wholesale? Retail?

For trade reasons most of the dealers declined to state exactly how much milk or cream they now handle. Two or three of the smaller dealers and two large contractors gave exact figures.

The Boston contractors report that their product is sold in Arlington, Belmont, Boston, Brookline, Brockton, Cambridge, Chelsea, Cohasset, Everett, Hull, Malden, Marlborough, Medford, Melrose, Newton, Quincy, Revere, Somerville, Southborough, Stoneham, Winchester, Winthrop, Woburn and Worcester.

Cream is also distributed in addition to the above localities in the following places: Abington, Attleboro, Amesbury, Barnstable, Fall River, Foxborough, Gloucester, Hanover, New Bedford, Provincetown, Maynard and Wareham.

Tait Bros. of Springfield report that their output is sold in Springfield, West Springfield, Holyoke, Chicopee and Fitchburg.

Question 3. — Approximately what proportion of your milk and cream sold in Massachusetts is produced in —

(*a*) Massachusetts?
(*b*) New Hampshire and Vermont?
(*c*) Maine?
(*d*) Connecticut?
(*e*) New York?
(*f*) Canada?

This question was asked in order to ascertain the amount of milk obtained in the different States and the Dominion of Canada, and particularly the proportion produced outside of Massachusetts. Owing to the absence of answers to question 1, the replies to question 3 cannot be used for this purpose, as they are expressed in percentage.

None of the cream sold by the large dealers doing business in greater Boston is produced in Massachusetts. Most of this cream comes from Vermont and Maine, and a small supply from Canada. Our own investigations, however, show that one contractor obtains a large amount of cream from Canada. These statements, are therefore by no means conclusive.

Question 4. — How much of your milk and cream is pasteurized? Where is it pasteurized? Type of pasteurizer?

Maximum temperature of which milk or cream is heated? Time held? Temperature of holding?

Is any of your milk or cream re-pasteurized? If so, state location and character of the first and final pasteurizing plant.

All the large dealers practice pasteurization except in the case of the small amounts of certified milk sold and of milk sold to milk peddlers. In general, the milk is pasteurized but once, at the headquarters of the principal receiving stations of the corporations. The holding process is used, the milk being held for thirty minutes at a temperature of 143° to 145° F. Some of the family cream is repasteurized. In general, a higher temperature is used in pasteurizing cream, the dealers stating temperatures as high as 165° F.

Questions 5 and 6. — Do you maintain a system of dairy inspection? If so, describe the principal features of your system of dairy inspection.

To question 5, 7 answered yes and 4 answered no. The typical system is to have the agents of the receiving stations inspect each dairy three or four times a year, score the same and urge the dairymen to correct insanitary conditions. No statement is made, however, as to whether or not dairies found dirty are excluded.

One of the largest dealers replying no to question 5, in his reply to question 6 showed he maintained an inspection system similar to the others, except that he did not score the dairies.

Several of the large firms have inaugurated features of inspection which deserve special commendation; for example, one dealer states they retain a chief inspector who is a thoroughly experienced dairyman, a graduate of the New Hampshire State Agricultural College, and supplement their inspection by illustrated lectures for the benefit of the producers on the sanitary and economic aspects of milk production.

Another company retains a veterinary inspector for the examination of the cattle and stables, and a bacteriologist of national reputation to supervise the bacteriological examinations.

Another dealer states that his inspector scores the farms using the United States dairy score card, and he also employs the honor system of inspection. The producer scores his own farm, answering monthly a list of four questions by yes or no. These questions are relative to cooling the milk below 50° F., having and using a milk house, whitewashing the stable, and the window and air space per cow. A cash premium is paid if these questions are answered in the affirmative.

Another dealer appears to get into the closest co-operation with the local boards of health. He very logically leaves it to the board of health to first score and issue a permit to the dairy before the milk is purchased. Thereafter they utilize their own inspector to see if the dairies keep up the original standard set. Whenever they find a decline in these standards the board of health is at once notified, thereby placing the responsibility for refusing the milk on the local board of health, as it should be.

One corporation makes a practice of having the creamery managers accompany the inspectors of the Health Department on their visits to the dairies, and your Board is satisfied from personal observation that they rigidly refuse to accept the product of any dairy, the score of which is below the requirements of the health authorities, until these dairies have complied with the recommendations of the inspector.

At the central plant of this corporation occasional examinations are made for bacteria and for sediment. If the milk exhibits any sediment, or if the bacterial content is found to be high, the producer is notified of this fact, and the subsequent shipments of milk are carefully watched to ascertain whether

or not the producer has complied with the suggestions made by the company.

One contractor, evidently missing the point of the question, rather ingenuously replied, "Yes, by our city inspector and also by the State Board of Health." Another contractor answered rather modestly, "No," but in all probability maintained a system quite as efficient as his larger competitors. He states, "Not a regular system, but I visit them if the milk don't suit."

Somewhat as an offset to the very encouraging and broad-minded policies which these contractors maintain and have instituted for the purpose of bettering the sanitary quality of their product, strict impartiality requires us to state that one of the dealers, who now states that he does not repasteurize at all, admitted under oath a few years ago that a portion of his product was occasionally submitted to a second pasteurization.

The reports of the special investigations made by your Board seem to indicate that the system of inspection operated by the contractor is not as efficient in certain localities as the contractor's replies would indicate. In fact, we are forced to conclude that the policy of using the local collecting agent as a dairy inspector frequently results in giving the dealers themselves an altogether erroneous impression of the sanitary conditions pertaining to the dairies from which they obtain their milk.

C. OBSERVATIONS ON PAST AND PRESENT INCREASE, DECREASE, FLUCTUATIONS AND GEOGRAPHICAL MOVEMENTS OF COMMERCIAL MILK AND CREAM PRODUCTION IN MASSACHUSETTS AND NEIGHBORING STATES AND THE PROVINCE OF QUEBEC IN RELATION TO THE MILK SUPPLY OF THIS COMMONWEALTH.

A study of the production of milk in Massachusetts reveals the fact that while there has been a constant increase in population in this State since 1885, at which time the statistics quoted begin, there has been, at the same time, a decrease in the number of milch cows kept in this State. From 1885 to 1890 there was a great increase in the number of milch cows. According to statistics the increase was at the rate of about

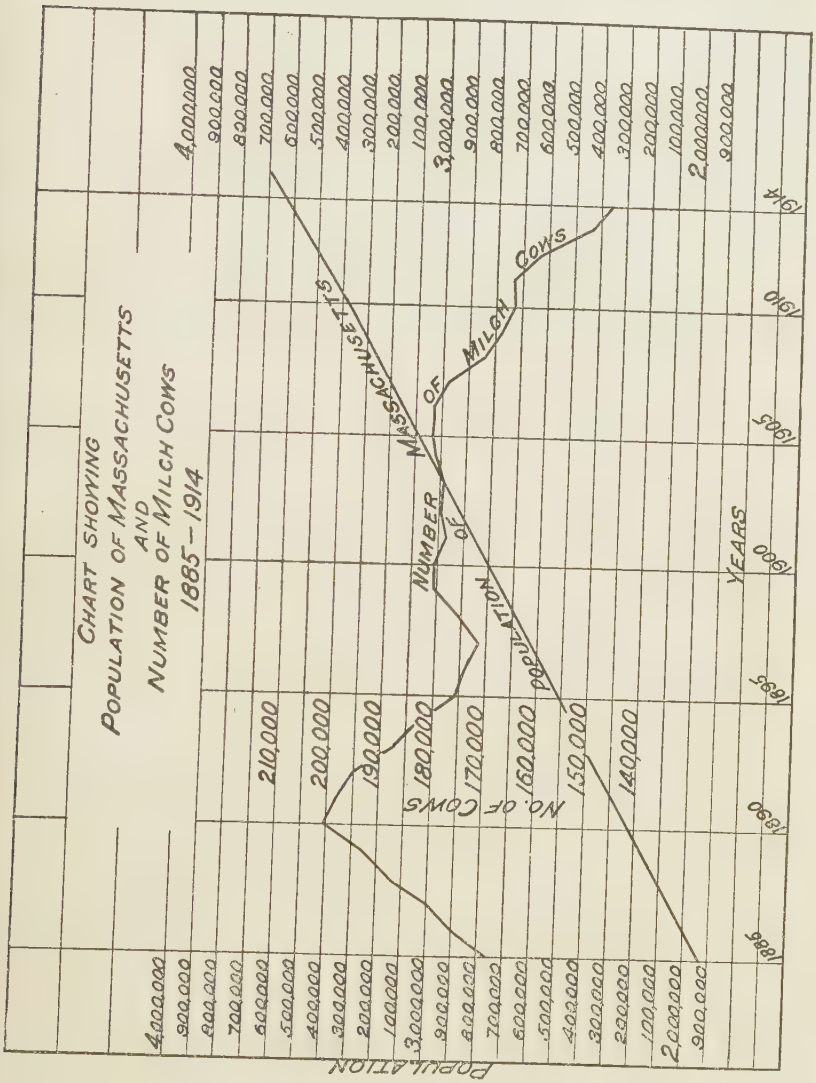
6,400 per year, and in 1890 the highest point was reached in the number of cattle, which was 200,658. From 1890 down to 1914 there has been a great, although not a uniform, decrease, but in the five years from 1890 to 1895 the decrease was almost as great as the increase had been in the previous five years. From 1895 to 1897 there was a decrease, although not as rapidly as in the previous five years. From 1897 to 1899 there was an increase in the number of cows kept, which in 1899 reached a total of a little more than 180,000. The number remained approximately stationary until 1906, and from 1906 to the present time there has been a rapid decrease at an average rate of 4,000 cows per year. From 1890, when the greatest number of milch cows kept in this State was reached, until 1914 there has been an average decrease in the number of cows of a little over 2,200 per year, so that while there was a production of milk at the rate of one-half quart per person in Massachusetts in 1890, in 1914 there was produced one-fifth quart per person in population.

Although the amount of milk used per person has increased according to different authorities, for the sake of comparison we will assume it to be the same.

Diagrams showing the comparative number of milch cows and the population of the State of Massachusetts, also showing the amount of milk brought into the city of Boston by the steam railroads for the years 1896 to 1914, are included in this report. The amount of milk and cream is given in millions of quarts, and there was a decided decrease from 1906 to 1911 in the amount handled on trains. From 1911 to 1913 there was almost as great an increase in the total amount handled on the railroads as there had been a decrease in 1906 to 1911.

Another interesting diagram shows the relative amount of milk handled by the three large railway systems coming to Boston. One curve shows the amount of milk handled by the Boston & Maine. There was a decrease from 1906 to 1910. From 1910 to 1911 the amount remained about the same, but from 1911 to 1913 there was a very rapid increase in the amount handled by this railroad, which increase corresponds to the rapid increase in the total amount of milk brought into Boston.

On the New York, New Haven & Hartford Railroad there was an increase in the amount brought into Boston from the



year 1906 to the year 1910, a decrease in 1912, and the amount remained about constant from 1912 to 1914.

In the case of the Boston & Albany there has been a steady decrease from the year 1906 to the year 1914. The increase in

the amount of milk brought into Boston by the Boston & Maine Railroad from 1911 to 1913 corresponds with the increase in the total amount of milk brought into Boston for those years. In 1913 to 1914 there is a decrease shown in the amount which also corresponds to the decrease in the total amount. The increase in the amount brought into Boston by the Boston & Maine not only corresponds to the increase in the total amount brought into Boston, but it also corresponds with the amount of milk brought into Massachusetts from the Province of Quebec by different Boston contractors.

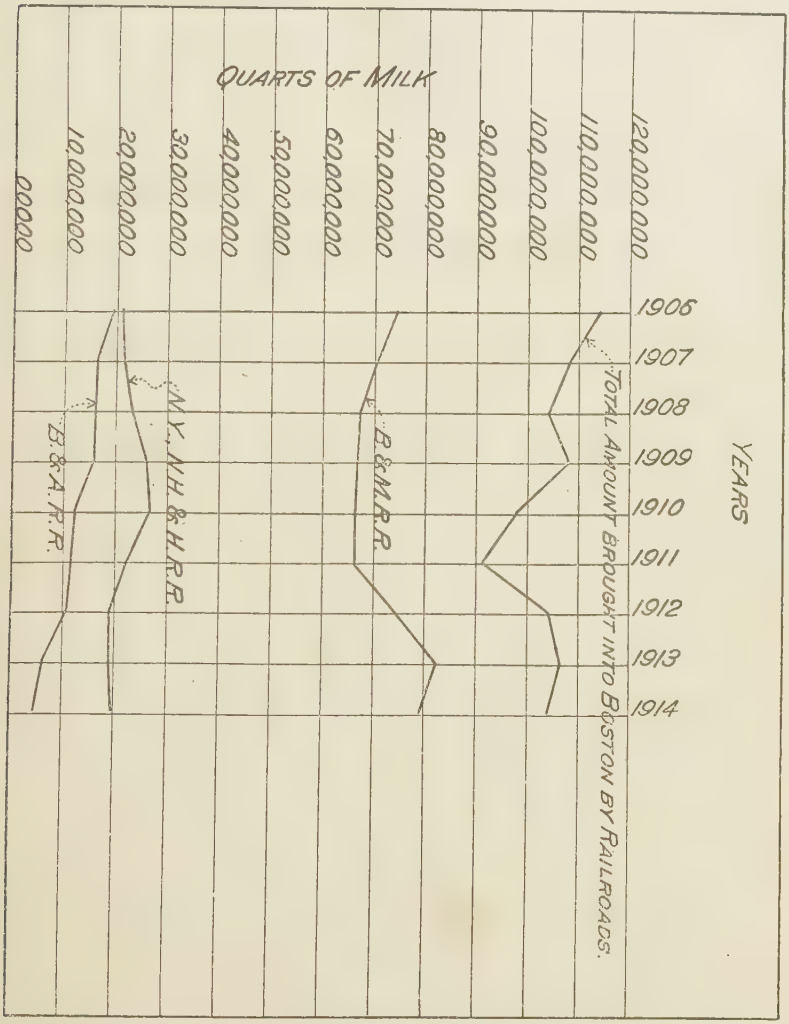
It would seem from the diagram that the milk contractors have been going farther from Massachusetts, as time goes on, to get the milk and cream with which they are supplying the people of this State.

A feature of the diagram is the notable decrease in the total amount of milk and cream coming into Boston in the years 1913 and 1914, whereas the increase in the population of Boston, or the metropolitan district, which probably receives most of the milk and cream which is brought into Boston by the railroads, has been at about the same rate as in previous years. This discrepancy has been studied with a view to finding out whether there has been a per capita decrease in the amount of milk and cream used as stated by several parties, but it has not been found that this is so. Neither has it been determined that people are using more milk and cream per capita than formerly, as has also been stated, but the amount probably remains about the same. A part of the decrease can be accounted for by the statements of some of the milk contractors that the surplus which formerly was shipped into Boston and manufactured into butter and other products at the Boston milk stations is now largely cared for out in the country, thus relieving the factories of some of the work, and resulting in a saving in railroad transportation. Probably the increased use of condensed, evaporated and powdered milk accounts for some of the decrease in the amount brought in by the railroads, as shown by the figures obtained from the Chamber of Commerce and agents of two of the large condensing and evaporating firms.

A study has been made to find out to what extent condensed, evaporated and powdered milk has taken the place of fluid milk

in manufacturing and in the homes, and these results are included with this report.

It seems to have been the general opinion of investigators of the past that the facts of milk production, especially from the



cost standpoint, should receive a great deal of attention, and, in fact, there has been a great deal of time, with attendant expense, devoted to this side of the question in milk production. There must have been good reasons for the study of the production costs when the question was a new one, but it seems

unnecessary to continue such work to any great extent, in view of the fact that all sides of the question have been thoroughly considered and the results have invariably been the same, and so far as can be ascertained no dispute as to the statements of cost has been made. Taking into consideration the fact that only a small percentage of the milk producers have kept itemized accounts that would enable them to accurately determine the cost of producing a quart of milk, and also the fact that conditions vary so on different farms even in the same locality, the question is raised as to the value of any one set of figures being greater than another. That the figures given by different producers who have testified at different investigations, and who have given this Board figures on the cost of producing, do not agree is no reason for condemning such figures, as the conditions vary so much on the different farms on account of the varied lines of agriculture carried on at these places that they may be just as accurate and reliable in one case as in another, and it would seem to be impossible to fix any exact price for which milk could be produced as long as it is produced under the many different conditions as at present. But as the cost estimates vary so slightly, that is, generally within less than a cent per quart, it would seem as though an approximate idea can be obtained of the cost in the different zones.

In some cases milch cows are kept as the sole source of income, and one will naturally think that in that case the lowest cost of production would be reached, but such is not always the fact, as in some of the cases the highest cost of production is reached. It is difficult to form an opinion as to the exact cost of production on those farms where the dairy business is run simply as a side line, as a part of the profits on these places is the fertilizer that is used in producing the vegetables or fruit, and it has been said that the value of the fertilizer varies with the value of the crop raised, so that some people have maintained that it was difficult to estimate the value of a cord of manure, as in some soils the value will be much greater than others. Stable manures have a much greater value than a commercial fertilizer containing the same amount of nutritive elements when used in a soil that needs the addition of humus.

It must be a fact that the cost of producing a quart of milk has increased in the last few years, as all of the material

used in the construction of buildings and the feeding of cattle has decidedly increased. The price of cows has greatly increased, and also the price of all farm labor. It has been stated by some of the milk producers with whom we have corresponded that the cost of producing a quart of milk has increased 15 per cent. in the last few years, and it is safe to say that the increased cost of producing a quart of milk is greater near the large centers of population than in the more remote districts, owing to the fact that labor costs generally more, and that taxes on farm lands have been increased more in proportion than they have in the outlying districts.

The element of pastures enters largely into the cost of the production of milk, because milk can be produced more cheaply in the sections where the pastures are good than in the sections where the pastures are poor. The dairying sections of the states of Vermont and New Hampshire can produce milk more cheaply for this reason than many sections of Massachusetts, and in proportion milk can be produced more cheaply in the Province of Quebec than in the portions of Vermont and New Hampshire mentioned. This is due to the fact that the farther north one goes from the city of Boston to the St. Lawrence River in Canada the heavier soils produce more and better pastures than the sandy soil in the eastern part of Massachusetts, and also to the fact that good pasture lands are much cheaper in Canada than in the New England States.

It is a mistake to say that because farmers do not keep an accurate set of books they do not know whether there is a profit or loss in the production of milk. In interviewing a large number it has been found that those who have been milk producers for more than four or five years have a very good idea of the cost of milk production which experience has given them. Almost any farmer of a few years' experience knows how much hay or other forage his place produces; knows in a general way how much money he is spending every month for grain; can easily tell whether his farm has increased in production; and, if he is dependent entirely on the dairy business, most certainly knows whether he has more money or less than formerly.

To give an idea of the importance of the dairy industry in the United States, statistics from the United States Census

reports are used as being the only ones available and with the belief that these figures are approximately correct; but it must be understood that these figures do not show anything as to the great importance of dairying in its connection with other lines of agriculture, which may well be said to rely upon the keeping of cattle for their perpetuation, and it is probable that many agricultural products would greatly advance in price owing to the difficulty of producing them without the animal fertilizers produced in dairying. It has been stated by competent judges of agricultural work that the only way in which milk production can be carried on successfully in New England is in combination with other lines of agriculture, and in the future we must depend upon the farmer who produces milk as one line of his diversified farming rather than on the men who will keep large herds of milch cows and follow milk production as an exclusive line.

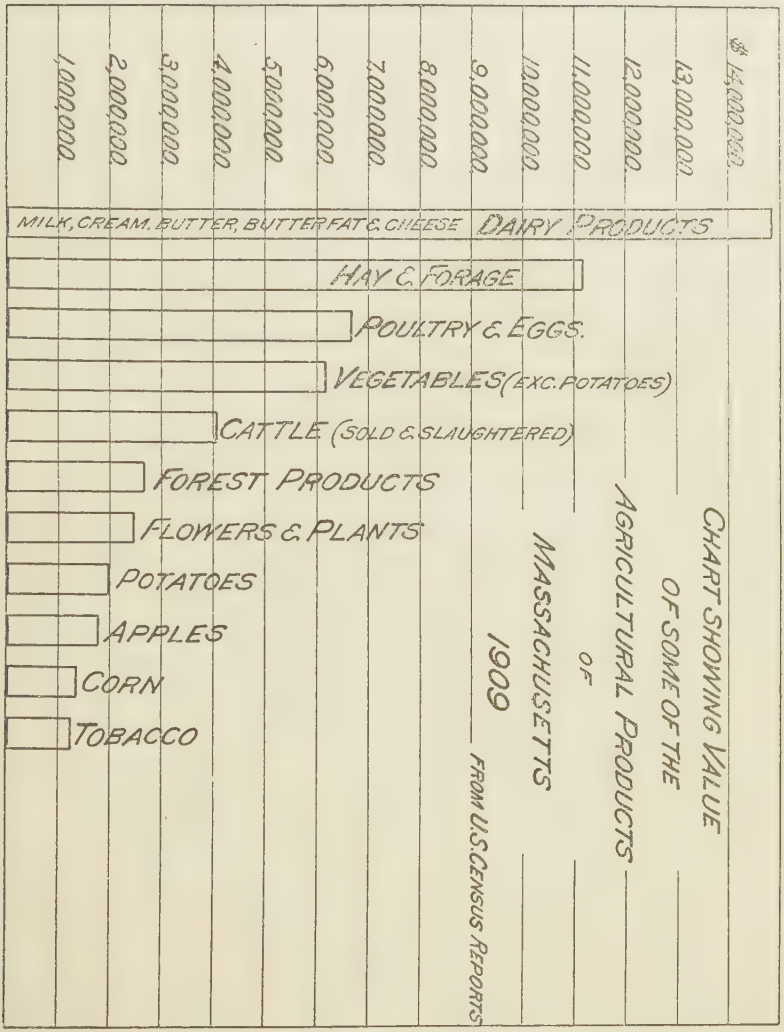
Milk production by small farmers as a side line would probably be much better for the consumer from a cost point of view, as it is extremely doubtful if a combination to raise or fix prices could ever be effected, and in connection with this statement it might be well to call attention to the statements of interested persons who have said that if it had been the custom of New England milk producers to conduct the business as an exclusive line rather than a side line the public long ago would have been compelled to pay a much larger price for dairy products. It is only because the other lines have been more profitable than dairying that the farmers have been able to produce milk and sell it at less than the actual cost.

Uses of Milk.

Cow's milk and its manufactured products have many uses, and there will always be a demand for this important article. Probably the most important use to which milk is put is the feeding of infants, and it seems improbable that we could ever find a substitute for milk for this purpose that would be as satisfactory or as efficient. Milk occupies an important place in the daily diet of many people who either have to use it as a portion of their food, or in some cases as their entire food on account of physical disorders, or who find it an agreeable and

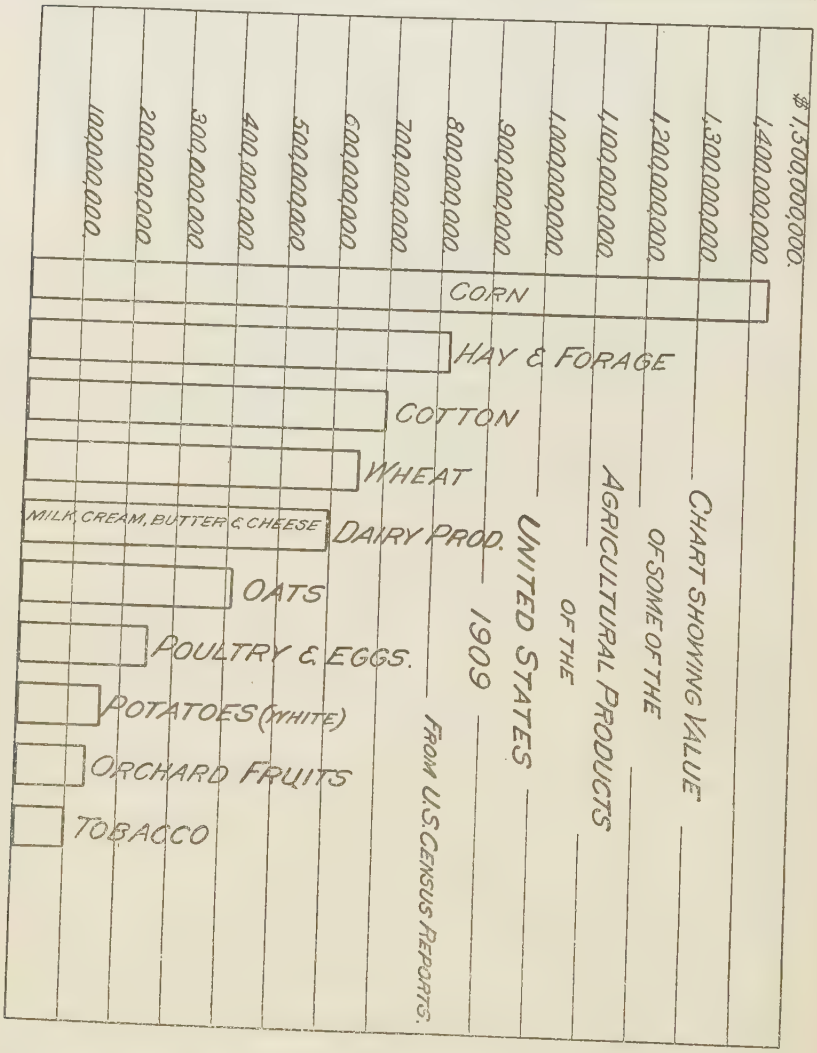
nutritious article of diet to be used daily in conjunction with the more solid foods.

The use of cream has increased very fast in the last twenty years, and is considered by many as an indispensable article



in the daily menu. The ice-cream business has assumed vast proportions, and the use of cream in the manufacture of ice cream is an important factor. Milk is used more extensively than ever before for cooking purposes, and bakers nowadays

make more products containing milk than formerly. Butter is too well known a commodity to require any comment, but attention should be drawn to the fact that buttermilk has a considerable market value at the present time, and its use as



a beverage has become quite a factor in disposing of the by-product of butter-making which formerly had little value. Cheese is a highly important product of the dairy industry, and its use is said to be increasing. The amount of butter and

cheese produced in Massachusetts is very small, and is generally produced for home use only.

By-products of milk are used in the manufacture of different articles to an extent that is almost incomprehensible to the uninformed. In considering the many ways in which milk is used, it is well to follow it from its point of production through the many hands and operations before it reaches the consumer. In New England, as a general thing, the whole milk is sold by the producers to large dealers who run cars out into the producing districts, and who either receive it at the car or at the local receiving station, where it may be separated and the cream shipped to the large centers and the skimmed milk used in various ways, or the whole milk may be shipped without any treatment except icing in a more or less efficient way. The whole milk or the cream may or may not be pasteurized at the receiving station or country creamery. The country shipping point may be 300 or more miles away from the main plant. If the receiving station is a creamery where butter is manufactured, the farmers generally bring in the whole milk, although in some cases they have separators and carry in only the cream. The farmers who bring in whole milk buy back the skimmed milk. The skimmed milk is used for feeding calves, hogs and poultry. It has been said that in former years some creameries followed the custom of either giving the skimmed milk away or throwing it on to the ground or into streams where it would flow away. In some parts of the country serious stream pollution has been reported in many cases where the latter method has been adopted, but it may be that the pollution was more the result of materials used in washing utensils and floors than of the skimmed milk. Of late years, where there has been a large amount of skimmed milk at the milk stations, it has become the custom to reduce the skimmed milk to milk powder for bakers' use, or for use in some instances in making a so-called synthetic milk by the addition of fat and water in proper proportions. In some instances it is made into a high protein feed for poultry, and to some extent is used in the manufacture of cold-water paint. Quite a considerable quantity of skimmed milk is condensed for use on board ships, etc. When skimmed milk is spoiled by age or in some other way, or where

there is no other method of disposing of it, the most common procedure is to manufacture casein.

Casein is used very extensively in the paper industry, making possible the manufacture of washable wall papers, also in the waterproofing of paper flasks, cartons and wrapping papers. It is used for coating paper slates and drawing papers, and as a fixing agent for enamels and colors on papers. Casein paints are quite extensively used, and the plasters which can be made by the combination of casein with other substances are useful in the decorator's art and for making molds. Insulators for electrical appliances and transparent sheets resembling celluloid and mica are manufactured from casein compounds, and in the dyeing and printing of textile fabrics it is also very useful. Casein is used in large quantities in the manufacture of linoleums, and, to some extent, in the compounding of medicines and foods.

When we consider how important milk has become as an article of food and in the arts and sciences, and how useful even the poorer parts and cheaper grades can be, it would seem as though the encouragement of the production of milk must surely tend to increase the general prosperity of the entire country. When we consider the enormous amount of money involved in the dairy industry of the United States, and the important uses to which dairy products are adapted, we are justified in pausing for a while before declaring that certain laws and regulations would be either beneficial or detrimental to this great industry.

Many reasons have been assigned or suggested as having had a direct influence on the decrease in the amount of milk produced in the State of Massachusetts. These are quoted not as matters of fact, but simply to record some of the ideas as expressed by various persons. Several persons have suggested that the past work of the State Board of Health has had a decided influence by reason of the methods employed in prosecuting farmers and others for offences against the law.[1]

Another reason for the decrease in production is said to be

[1] The critics did not take into account the fact that the State Board of Health had for years practiced the warning system with no advantage, and the new secretary furnished the inspectors a long list of the people who had been warned. The samples collected resulted in a large number of prosecutions. — H. C. L.

the result of milk-borne epidemics being sensationally featured by the newspapers. This publicity is said to have resulted in a decrease in the amount of milk consumed for at least a time. Many producers have stated that a large part of the decrease has been due to the feeling of unrest and insecurity on the part of the farmers, occasioned by the constant agitation, legislative and otherwise, that they have been subjected to for the past several years, and some have said that improvements have been delayed in many cases because dairymen were afraid that it would not pay them to stay in the business if drastic laws were to be passed.

Another reason is said to be the constantly increasing use of condensed and evaporated milk by families and the increase in the amount of milk powders used by bakers. Probably the increased use of milk powders and of condensed and evaporated milk is responsible for some of the decrease in the amount of milk brought into Boston by the different railroads in the year 1913, and also for the general decrease of about 10,000,000 gallons in the yearly amount between the years 1906 and 1914.

How much bearing the financial panics and bad business conditions of different periods may have had on the amount of milk produced and the amount consumed is problematical, but we may well assume that such conditions have had their influence.

A large number of dairymen have given the low price paid to the producer as the principal and almost only reason for the great decrease in production in this State. This seems to be the most reasonable one, because many of the producers have said that the price received for milk during the last few years has not been sufficient to enable them to make a profit, and that in many cases the price paid was below the cost of production.

It has been stated by many dairymen that the production per cow in Massachusetts has increased from 10 to 15 per cent. in the last fifteen years, this increase having been secured by more careful selection of cattle, breeding for production, and because of a better knowledge of the problems of feeding. Some have claimed that the greater production of the Massachusetts herds over those of other States and countries

should have helped the dairymen in overcoming the difference of cost in production between this State and States farther north, where the pasture conditions are better than they generally are in Massachusetts.

Criticisms have been made of the result of the Saunders law, which at one time was believed would help Massachusetts producers, but many have expressed the opinion that it has really resulted in hurting the Massachusetts industry.

Another reason assigned as the cause of decrease in production in the State of Massachusetts is the growing interest taken in fruit, vegetable and poultry raising by farmers who were formerly engaged in dairying.

Scarcity of labor at reasonable prices has also been given as one of the reasons for the decline, and some farmers claim to have been discouraged by the fact that the only laborer available at any price in some districts is the foreign-born laborer, who does not understand the English language, and who understands but little of farming conditions and work in this country; and it is a fact that new arrivals on these shores demand, in many cases, $30 to $35 per month and board, and generally obtain these prices on account of the scarcity of laborers.

An interesting feature of the business of milk production in Massachusetts at the present time is the work being done by the State Board of Agriculture, through its Dairy Bureau, along the lines of the encouragement of a greater production of milk of a high quality. For the purpose of interesting Massachusetts dairymen the Legislature has appropriated money to the State Board of Agriculture, and they have conducted for the last three years a series of clean milk contests, which has resulted in the production of high-class milk on places which formerly had been somewhat indifferent to some of the necessary details of clean milk production.

The Milk Board in conducting its dairy investigations has visited several places that have been entered in these clean milk contests, some of which have won prizes. The winning of a prize in these contests has meant a great deal to the winners, as it has resulted, in some instances, in their getting a better price for milk when they distributed their milk direct to the consumer.

There are some good figures available on cost of production of milk in Massachusetts, probably none of them better than those of Elmer D. Howe of Marlborough, a practical dairyman, who is a graduate and trustee of the Massachusetts Agricultural College, and also a past master of the Massachusetts State Grange. The figures are based on his own herd of 40 cows. Mr. Howe says: —

Our experiment stations agree that the average cow in milk needs, for economical production, 25 pounds of hay or its equivalent in silage, roots, etc., plus 8 pounds of grain. This will make the food cost per day (with hay at $20 per ton and grain at $30 per ton) 37 cents per cow.

For 40 cows, food cost per day equals	$14 80
A building for housing stock and hay will average to cost $100 per cow; interest on $4,000 at 5 per cent. equals per day,	60
Depreciation of building at 5 per cent. per year equals per day,	60
Depreciation of cows and loss in replacing equals per day (low estimate),	75
Taxes on building and cows (not on land) per day,	20
Milking 40 cows at 20 cents per hour equals per day,	1 60
Grooming 40 cows equals per day,	40
Cleaning stables and feeding per day,	60
Wear and tear of small tools, currycombs, brooms, etc., including service of bull, cost of city water, veterinary fees, ice, light, etc.,	15
	$19 80
Against this we have a credit of $2.50 per day for manure and 30 cents per day for calves born during the year (calves at $3 each at birth),	2 80
Net cost for 40 cows per day,	$17 00

For more than fifteen years we have weighed every cow's milk both morning and night, and our records show that our cows (and we keep none that give less than 5,000 pounds per year) average just about 7 quarts per day. Forty cows, then, will average to produce 280 quarts of milk per day at an average daily cost of $17, or a trifle over 6 cents per quart.

By substituting 30 pounds of ensilage for 15 pounds of hay in the daily ration of each cow we are able to cut the cost to about 5 cents per quart, but the closest scrutiny will not reveal any other item where a saving can be made.

That Mr. Howe's figures are not too high is obvious when we consider that he has made no account of waste in handling, superintendence or profits beyond interest at 5 per cent.

Prof. John M. Trueman, formerly of the Connecticut Agricultural College, Storrs, Conn., says: —

Cost of Feeding.[1]

Silage, 4 tons at $4,	$16 00
Hay, 1½ tons at $16,	24 00
Grain, 1½ tons at $30,	37 50
Pasture, four months,	8 00
Total,	$85 50

In years when pasture is short, and grain and silage or green fodder must be fed all summer, the cost per year will frequently go up as high as $100.

The total cost of keeping each cow per year, therefore, is as follows: —

Feed,	$85 00
Bedding,	5 00
Keep of bull (for herd of 25 cows),	3 00
Taxes on cow and barn,	1 25
Interest on money invested in cows,	3 75
Barn rent,	3 00
Insurance,	40
Depreciation of cow,	13 00
Light, medicine, etc.,	2 00
Labor,	33 60
Total,	$150 00

The cows thus fed and cared for included Jerseys, Guernseys, Ayrshires and Holsteins. Some were very good producers, others only fair. The average for the whole lot for the five years was 6,378 pounds per cow, which, on the basis of 2¼ pounds to the quart, is equal to 2,834 quarts. Although this is not a heavy yield, it is a good average for a herd of 25 cows made up of several breeds. It requires extra skill and good management to increase the yield beyond this point. When it is remembered that the average yearly production for the New England States is less than 2,200 quarts per cow, it will seem that a herd making over 2,834 is doing fairly well. It is useless, therefore, to hope to decrease the cost of milk by much further increase in the yearly production of the cows. Any material increase over 3,000 quarts in a large herd comes high from the necessary weeding out of ordinary producers and the small numbers of high producers to be found.

The cow should be credited with her calves and with the manure she makes. We cannot allow more than $5 per year for calves, nor more than $10 per year for manure in the barnyard. We can, therefore, credit the cow with $15 and subtract that amount from the $150 that it cost to keep her. This leaves $135 to be balanced by 2,834 quarts of milk, which would require the milk to be sold at the farmer's door for practically 4.75 cents per quart. This amount simply pays for the actual cost of

[1] These figures represent the average cost of five years, 1907–11, and are somewhat too low for 1913.

the investment and labor put on the milk. It allows nothing for the farmer's skill as manager, nor for the extra hours he must work planning for the improvement of his herd and the running of the business, and nothing for the profits. He has simply received 5 per cent. on his investment and common laborer's wages.

If he is going to improve his farm and build up a permanent agriculture in an advancing rural community, and continue in business, he will require 5.75 cents or more per quart to pay the bill.

Fred Rasmussen, professor of dairying, New Hampshire Agricultural College, Durham, N. H., says: —

The last census report shows the average production of milk per cow in Massachusetts to be 4,524 pounds, in New Hampshire 3,775 pounds, in Vermont 3,982 pounds. No doubt the actual production in the several States is higher than this. In the writer's opinion a more nearly correct estimate is between 5,000 and 5,500 pounds of milk.

To get conditions which will represent average production for Massachusetts, New Hampshire and Vermont let us take the 39 cows, of the 26 herds[1] studied, producing between 5,500 and 6,000 pounds with an average production of 5,540 pounds of milk.

The Cost of Production.

Cost of feed,[2]		$66 91
Labor,		32 33
Delivery,		6 16
Housing,		9 05
Depreciation,		8 83
Bedding,		4 00
Bull,		3 79
Taxes and interest,		4 55
Ice, coal and wood for heating,		2 17
Veterinary service and medicine,		87
Tools, utensils, salt, etc.,		53
		$139 19
Credit: —		
Manure,	$15 00	
Calf,	3 00	
		18 00
Total,		$121 19

[1] See Circular No. 8 of this series; also Bulletin No. 2, New Hampshire College and Experiment Station.

[2] It costs less to feed these "average" cows than it does higher producers, which accounts for the difference in figures here given from those used in Circular No. 8.

Comparison of Increase in Cost of Production with Increase in Price obtained by Farmer.

The following table gives comparison of cost of feeds and prices received for milk, 1904 to 1912. The prices are those of the Boston Chamber of Commerce, and records compiled by J. B. Lindsey. The price of milk per quart to the farmer is the price paid in the middle zone by one of the largest milk contractors in Boston. The price paid by the consumer for milk is the price paid for milk delivered in glass bottles for family use in Boston.

Article.	Hay, Grade No. 2, per Ton.	Linseed Meal per Ton.	Distiller's Grain per Ton.	Bran per Ton.	Gluten Feed per Ton.	Corn Meal per Ton.	Cotton-seed Meal per Ton.	Milk.	
								Farmer's Price per Quart (Cents).	Consumer's Price per Quart (Cents).
Prices in 1904, ...	$13 00 to $16 50	$25 17	$24 31	$20 87	$24 24	$23 68	$26 52	3.24	7.50
Prices in 1912, ...	$21 50 to $28 00	$39 30	$39 94	$27 96	$31 51	$30 20	$31 20	3.9	9.00
Increase in per cent., ...	57.7 to 64.7	56.2	35.5	34.4	29.9	27.5	27.6	20.4	20.0

Professor Lindsey gives the following figures on the cost of production of 131 cows from 1896 to 1911: —

Average yearly food cost per cow,	$89 24
Net yearly fixed charges per cow (estimated),	$56 00
Total cost per cow,	$145 24
Average yearly yield per cow (pounds),	6,036.3
Average yearly yield per cow (quarts),	2,683
Cost of milk (100 pounds),	$2 41
Cost of milk (1 quart) (cents),	5.43

Financing the Cow.

Few people have any idea what it costs to finance the cow. We know of no New England data upon the subject. The New York Experiment Station at Geneva has made a study of this question as applied to the milk supply of that city, and Bulletin No. 563 says: —

> Considered from the agricultural standpoint, the capitalization amounts to $763 per cow, of which the producer furnished $680 and the retailer $83.

In other words, it costs the milk producers supplying milk to Geneva, N. Y., a city of about 13,000 inhabitants, $680 to finance each cow, and it costs the distributors $83 to finance the distribution of the milk of each cow.

The capital invested was estimated as follows: —

600 cows at $80,	$48,000
3,000 acres of land with buildings,	300,000
Equipment, $20 per acre,	60,000
	$408,000
Capital invested in distribution,	50,000
Total,	$458,000

That the Massachusetts dairyman is progressive is evidenced by figures of milk production in Massachusetts as compared with the States of Vermont and New Hampshire.

Professor Rasmussen says that the average annual production per cow in those States is as follows: —

	Pounds.
Massachusetts,	4,524
Vermont,	3,982
New Hampshire,	3,775

Assuming that a quart of standard milk weighs 2.15 pounds, the production in quarts per day would be —

	Quarts.
Massachusetts,	$5\frac{3}{4}$
Vermont,	5
New Hampshire,	4.8

These figures are interesting in view of the fact that Vermont has generally been considered the dairy State of New England.

An interesting feature is the belief of admirers of different thoroughbred varieties of cattle that the breed which they admire is the best for certain purposes, which ideas are not always substantiated by facts. Too much emphasis is laid on individual work and not enough on herd work; as, for instance, in the Holstein breed the herd records, so far as we have them, are in no way comparable with individual records, and it is a mistake to think that thoroughbred herds exceed in production, to any great extent, the good herds of grade cows; at least, the observation of the committee has shown it thus.

That there are fads and fashions in all things is just as true of the dairy business as of other things, and many a dairyman owes a part of his failure in dairying to the fact that he has been caught by a fad.

Fads in feeding cattle have followed a knowledge acquired after patient study and research by competent persons, by parties who have absorbed only a part of the idea and have had the benefit of other conditions to help them out for a while; but when the favorable elements have been removed they found that the profits have been wiped out by wasteful and injudicious feeding methods, also by dairymen following ration formulæ used by gentlemen farmers and others in trials for advance registry records. Such fads and heavy feeding methods have resulted in very many cases of udder troubles that seriously affect the quality of the milk from such cows, both from a health standpoint and also a commercial point of view, as well as being a deteriorating factor in the value of the cow.

If there has been a profit in milk production in Massachusetts in the last few years among those dairymen who sell their product to the large dealers, it has been among those

who raise the largest proportion of the stock feed on their own place. This class of producers, that is, the ones who raise most of the fodder and a good part of the grain used in feeding their herds, do not as a general thing produce as much milk or cream as those who buy and feed generously the high concentrates now common in the markets; but they do keep a larger part of the gross receipts in their own pockets, and the cattle fed in the old-fashioned way are almost invariably healthier and remain producers longer than the highly pampered and fed cattle. Cases of milk fever, garget and other udder troubles, and also tuberculosis, are less prevalent in herds that have not been crowded.

The old-fashioned way spoken of is the one followed by many Worcester County farmers formerly, and by a less number now, and the ration is generally composed of hay, clover and cut dry corn stalks for roughage, turnips and mangles for succulent feed, and the field corn ground into what is called cob grist, — that is, the whole ear is ground and fed as meal with some of the wheat feeds, such as bran or mixed feed, — and by this method of feeding, which gives a good nutritive ratio, the highest natural production can be obtained. Any crowding with concentrates is unnatural, and requires the best efforts of an expert cattle feeder to keep the herd in good shape.

Large and Small Herds.

The cost of maintaining a large herd of cattle is less in proportion in some ways and not in others, for while any large business is done on a more economical basis than a small one when materials are bought, still, the smaller dairies that are run in conjunction with general farming are sometimes more profitable in proportion, as they provide something for the farmers to do in the winter time when other lines of his business are at a standstill.

Condensed and Evaporated Milk and Milk Powders.

An Interview with Mr. W. J. Reid, Local Manager for the Van Camp Company.

Mr. Reid says that the Van Camp Company's business in evaporated milk increased at least 100 per cent., perhaps 125 per cent., from 1906 to 1914, and that the business was very

profitable from 1906 to 1912. Since 1912 there has been no profit in the evaporated milk business, owing to the increased cost of everything used in the manufacture and shipping and to the scarcity of milk. The Van Camp evaporating plants have been running half time recently, owing to the scarcity, and in 1910 a large plant that the company was running at St. Albans, Vt., was discontinued, as not enough milk could be obtained to make it profitable. Mr. Reid says that the cases in which the evaporated milk is packed now cost 18 cents apiece where formerly they were bought for 5 cents apiece. The cans used in putting up the milk cost at least 40 per cent. more than a few years ago. The labels also have increased in price, and there has been a considerable increase in the price paid for labor, but in spite of these increased costs the price of evaporated milk per case, for the year 1915 averaged $3 a case, against a price of $3.55 per case in 1912. Mr. Reid made the statement that his firm believed that there was no profit in the evaporated milk business at the present time (1915), nor would there be any until the consumers were willing to pay more than they do. Keen competition among the manufacturers of evaporated milk made it impossible to do anything in a general way toward advancing prices. Mr. Reid said that the evaporated milk business was the only one of their many lines where the manufactured product did not respond to the market price of the raw material, and said that all other lines that they handle were advanced or lowered in price to correspond with market conditions. For instance, their best brand of baked beans is now selling for 20 cents per can instead of 14 cents as formerly, and this is due to the advanced price of the raw bean.

Interview with Mr. George Wm. Bentley, Agent for the Borden Condensed Milk Company.

Mr. Bentley says that at the present time the condensed milk business is not in a very satisfactory condition; that it is impossible for him to get enough condensed milk from the factories to fill their regular orders; that the reason for this is the scarcity of the raw product; and that so scarce is the fluid milk for manufacturing into condensed milk that their company is now going into Canada for more milk and to open manufactories. He also says that until within two years the

condensed milk business had increased at the rate of about 15 per cent. per year since 1906, but that it was now falling off almost as fast as it had increased up to 1912. Part of this decrease is due to the fact that there is a less demand, and part to the above-mentioned shortage of the raw milk. Mr. Bentley said that the less demand by the public might be due to the financial conditions of the past few years, but did not see why there should have been any idea that this was economy, as he considered that the public was getting more for their money when they bought milk or any of its products than in any other line of food. Mr. Bentley very kindly offered to give the Milk Board figures to show the amount of condensed milk his firm had handled for several years back. These figures have not yet been acquired by the Milk Board.

Interview with Mr. Louis W. de Pass, in Charge of Statistics at the Boston Chamber of Commerce.

Mr. De Pass gave the figures on the amount of condensed, evaporated and powdered milk coming into Boston for the years 1912, 1913 and 1914, with the amount from Jan. 1 to Nov. 1, 1915. Mr. De Pass only began to keep these figures in the year beginning 1912. The amounts are as follows: —

	Cases.	Barrels.
1912,	321,946	2,304
1913,	321,883	3,484
1914,	432,601	851
Jan. 1 to Nov. 1, 1915,	326,474	5,145
Jan. 1 to Nov. 1, 1914,	355,932	606
November, 1914,	34,253	40
December, 1914,	42,416	205

In the opinion of Mr. De Pass there has been a decided increase in the amount of condensed and evaporated milk handled for the last few years, and he did not think that the financial conditions of the last few years had caused any decrease in the amount of this product coming into the city of Boston.

The figures quoted are made up from the dairy returns of all the railroads running into Boston, and are said to be accurate, but there has been no attempt made to separate the different kinds of milk preparations.

Comments on Milk Production.

Although considerable time has been spent in the investigation of the different factors entering into the business of milk production, it is by no means certain that enough information has been gathered from which to draw conclusions as to the exact condition of milk production in Massachusetts, and it would be unwise to make any efforts toward the regulations of the dairy business from a health or any other standpoint until the findings of this investigation have been carefully reviewed, as there is a possibility that the dairy business in Massachusetts is in danger of becoming almost entirely eliminated unless something is done to restore confidence.

A study of the census reports shows that in all of the New England States, except Rhode Island, there has been a great decrease in the number of milch cows kept, this decrease being most pronounced since 1890; that the consuming public of Massachusetts has been obliged to use milk from dairies far beyond the points where the milk supply was formerly obtained; and that the distance has steadily increased and nearby production has steadily decreased, so that it would appear as though the future generations would have but a small amount, if any, of milk from near-by points.

If milk is an important article of food, and if the quality is at all an important feature, it is evident that it becomes necessary that the near-by production of milk should receive such encouragement as can be given. Although the milk business owes its principal decline to strictly commercial causes, it must be revived for more important reasons than that of commercial interest, and one of the most important and vital reasons is the preservation of the life and health of our people.

That milk is a necessary article of diet is admitted by all, and its importance in the diet of infants and invalids is incalculable, because on the use of cow's milk depends the lives of many, who, from unavoidable causes, are compelled to rely on

it for varying periods of time. It is said by several authorities that breast feeding of infants is on the decline in this country, and if that is a fact, then we must depend more and more on the cow to provide sustenance for those who unfortunately are denied their natural food.

If the statistics in regard to milk production gathered during this investigation are correct, and we believe them to be so, then we must be approaching at a greater or less rate of speed the time when a good quality of cow's milk for our infants' nourishment will become a rare and consequently high-priced article. It therefore seems as though the complaints of the future would be numerous in regard to the milk situation, but along distinctly different lines than at present. If the production of milk within a reasonable distance of the city of Boston shall decrease as fast in the next twenty-five years as it has in the past twenty-five years, and the farmers in zones that are now supplying a large part of the milk which was formerly produced nearer Boston become convinced of the fact that milk production is a financial failure under prevailing conditions (and personal interviews with many producers of those zones have shown us that the more thoughtful ones believe this to be the case), it is only a question of time when we will have no adequate locally produced milk supply suitable for infants, invalids or those who need it as an article of daily diet.

It has been suggested by some farmers that the best way to remedy the financial conditions under which producers labor at the present time, and have for some time in the past, is for the dairymen to cease the production of milk and go into other and more remunerative lines of agriculture, with the expectation that a shortage in the supply of milk would bring an advance in prices that would make the production of milk a paying line of agriculture. This idea, however, is probably an erroneous one, for it is well known that those dairymen who have given up milk production and have engaged in vegetable, fruit or poultry raising, or other agricultural lines, have seldom returned to dairying because it is much more exacting in regard to hours and close application throughout a whole year than is the production of seasonable crops or poultry husbandry; and also because a return to the dairy industry means either

a large outlay of money at the start or a slow process of building up a herd with which to do business.

An important reason why the dairy business should be encouraged is that all other lines of agriculture depend largely on the animal fertilizers for best results in growing farm crops, and except in a small percentage of cases farms certainly do run down and become less productive where the animal fertilizers are lacking.

It is a fact that some farms have been successfully run on commercial fertilizers and green manures, but it does not seem probable that the method will ever become general, as it requires more than the ordinary amount of scientific knowledge of chemistry, etc., than we can expect to find among our common farmers.

Agriculture along the lines now common in our New England States must be fostered if we are to continue to have a supply of the native-grown fruits and vegetables that we are accustomed to, and no one should dispute the statement that New England quality in all lines of fruits and vegetables native to these States is high.

The working classes are the ones who must bear the burden of the high cost of living, and to them any advance in price of any necessary article of food is of great importance, and it is very necessary that in the study of conditions relating to the production of milk due consideration should be given this part of the subject.

The lack of uniformity in the price paid to producers of milk whose output comes into the Massachusetts market is apparent, and the Milk Board has found in their investigation that the amount paid per $8\frac{1}{2}$-quart can varies from 25 to 56 cents per can in different sections of New England, but as only a small part of the total is sold for the latter price it is very difficult to say what the average price may be. The estimated average price paid is 31 cents per $8\frac{1}{2}$-quart can, and the estimated average price to the consumers is 9 cents per quart, or about 75 cents per $8\frac{1}{2}$-quart can. Our investigation has shown that the retail price of milk of the ordinary market quality varies from 6 cents per quart in the town of Great Barrington to 12 cents per quart in the towns on Cape Cod, where

the greater part of the milk is produced in the summer season to be sold to summer residents. Certified milk seems to be a small part of the total amount, probably less than 1 per cent., and the prices are said to vary from 12 to 20 cents per quart, although a small amount is sold at a higher price. It has been ascertained that producers in the State of Maine are paid a much better price for milk by a large concern doing the principal business in that section than are producers in other sections equally distant from Boston who deal with other companies. There is also a lack of uniformity in deducting the transportation charges from what is called the Boston price, which transportation charges vary in the different zones.

It is said that in some instances milk is transported by railroad twice as far for a given price as it is in others, which, of course, must increase the unfavorable conditions surrounding the milk industry.

The management of the Boston & Maine Railroad has recently petitioned the Massachusetts Public Service Commission for permission to increase rates for hauling milk, but nothing has been done along this line, as it has been claimed by some of the interested parties that it is an interstate question, and must be settled by the United States Interstate Commerce Commission.

In one of the Boston Sunday papers of Jan. 9, 1916, a statement was made that the Interstate Commerce Commission is to make an investigation of milk transportation rates in the New England States.

Any increase in transportation rates at this time must mean an increased price to the consumer, as the producers cannot stand a smaller price than they are now receiving, and the dealers have stated that they cannot do business on a smaller margin of profit than that which they now receive.

A study of one of the accompanying charts shows the values of some of the principal agricultural crops of the United States, and also that dairy products rank high in value. When we consider that where dairying declines other agricultural lines suffer great loss, and where agriculture is neglected or becomes unprofitable all business lines almost instantly respond to the decline, and if agricultural work is profitable then all other

business lines are profitable, we are justified in considering that dairying is an important industry in Massachusetts.

To give an idea of the financial importance of dairying in Massachusetts the following figures are given: 147,000 milch cows at an average value of $60 each equals $8,820,000; 147,000 cows yielding $5\frac{3}{4}$ quarts per day each at a value of 4 cents per quart equals $33,800 per day; $33,800 per day multiplied by 365 equals $12,307,000 per year, as a rough estimate of the value of the present milk production in Massachusetts. Using figures of the New York Experiment Station on financing the cow, 147,000 cows at $680 each equals $99,960,000 to finance the cows of this State.

If we estimate the number of people employed in caring for the milch cows of this State as 1 person per 8 cows, we have 18,375 persons daily employed in this work. These figures show the dairy industry of Massachusetts to be important, and although it is impossible to say what the effect of the elimination of dairying in Massachusetts would be, it would certainly have a very depressing effect on other lines of business activity. Any increase in the dairy industry of Massachusetts must certainly tend toward a greater prosperity for all connected with the agricultural interests of the Commonwealth and for those firms or individuals who rely upon the residents of the rural districts for their commercial success.

D. THE COMMERCIAL PASTEURIZATION OF MILK AND CREAM.

Pasteurization is the term applied to the process of heating a substance to a temperature sufficiently high to destroy or greatly reduce the bacterial content without causing appreciable chemical changes in the substance. The commercial pasteurization of milk as generally carried out in the State of Massachusetts consists in heating the milk to a temperature of 145° or 150° F., and holding the heated milk at a temperature of 142° to 144° F. for a period of from twenty to thirty-five minutes, after which it is immediately cooled. In a few instances, however, dealers still employ the flash process of pasteurization, by which the milk is momentarily heated at a higher temperature and is immediately cooled.

In the milk-pasteurization plants the milk is heated very quickly, generally under automatic temperature control and record, after which it is transferred to the holding chambers which may be of the continuous or of the intermittent type. In either case the temperature of the milk is usually recorded as the milk leaves the chambers for the cooler. In a few instances the milk is heated slowly in bulk, and held at the temperature of pasteurization for the necessary time in the same tank in which it was heated, after which it is cooled and bottled in the usual manner.

The sale of milk heated to a temperature greater than 167° F. is prohibited in Massachusetts unless labeled "Heated Milk." This statute is difficult of enforcement, as it is almost impossible to determine by laboratory methods the exact temperature to which milk has been heated, and in order to obtain the necessary evidence to prosecute for a violation of this law the investigator must see the milk pasteurized, and must of his own knowledge know the temperature to which the milk was heated.

The first noticeable effect of heat upon milk is the production of a cooked taste which, however, depends to a large measure upon the temperature of heating. If the temperature is not too high this taste will disappear in eighteen or twenty hours. The chemical effect of heat on milk is the destruction of the so-called enzymes, and, as the temperature is increased, the coagulation of the albumin, and if a temperature greater than the boiling point is reached the sugar may be caramelized. The exact nature and significance of the enzymes present is a matter of controversy among those scientists who are trying to solve the problem, but a study of the literature shows that milk gives reactions which may be explained by the presence of enzymes. Under this assumption it may be stated that raw milk contains a diastase capable of hydrolizing 0.01 to 0.02 per cent. of starch, a catalase which will liberate oxygen from hydrogen dioxide, a peroxidase which will cause hydrogen dioxide to react with certain organic substances, thereby producing colors, and reductases capable of reducing methylene blue solutions to a colorless compound. These reactions are not only influenced by the temperature to which the milk is

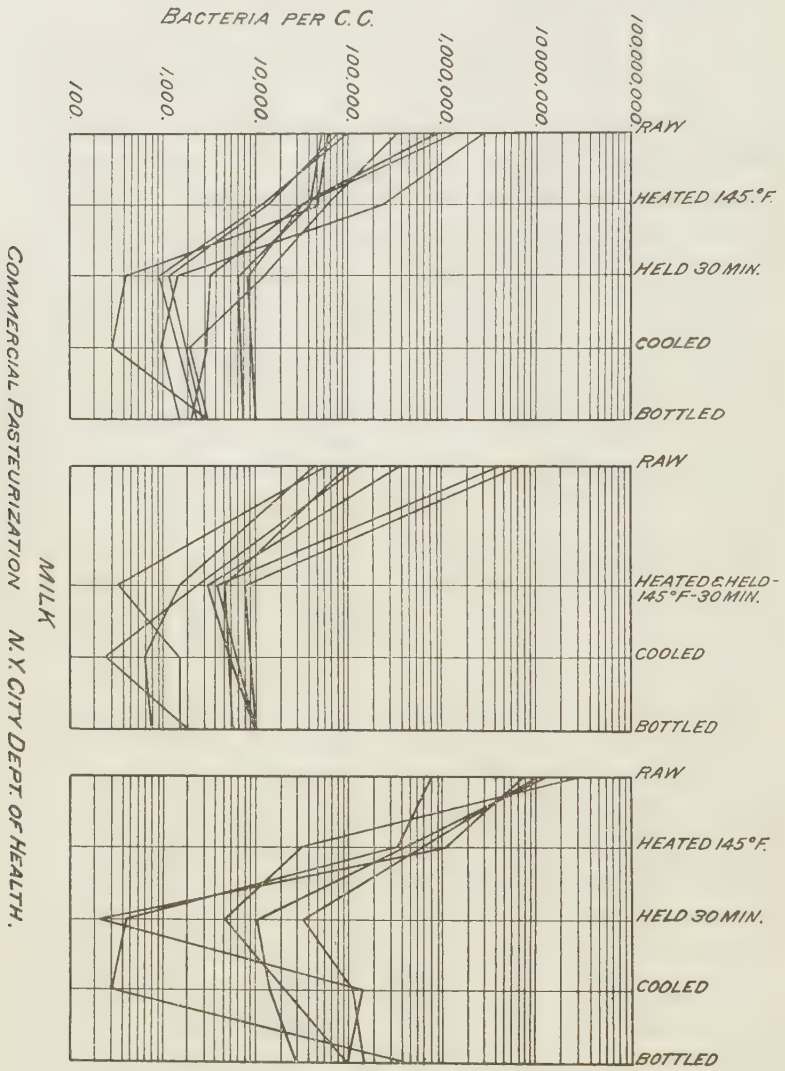
heated, but by the length of time during which the temperature is maintained, and also by the age of the milk. The diastase is destroyed by commercial pasteurization, and this is also true of the formalin-methylene blue reductase, but this latter reaction returns three days after pasteurization, probably the reacting substance being reproduced by the growth of bacteria. The peroxidase reaction is not affected by the commercial pasteurization of milk, as shown by the work performed with this reaction in the Food and Drug Laboratory of the Massachusetts State Department of Health during the year 1913.

As the destruction of this reaction is coincident with the coagulation of the albumin, and since the reaction may be a function of the albumin, it follows that there is undoubtedly no change in the milk proteins by commercial pasteurization as now practiced. When it is considered that milk with a cooked taste is liable to have a limited sale it is evident that the milk dealers will endeavor to keep the temperature as low as they possibly can and produce the required results. An added incentive to keep the temperature of pasteurization low is the fact that if milk is heated to a high temperature the cream does not rise well, and the bottle of milk will not show the cream line by which the public judge the quality of the milk they receive.

Proper pasteurization will cause an enormous reduction in the bacterial content of milk, and, owing to the fact that pathogenic bacteria are killed at a lower temperature than most forms of lactic acid bacteria, the milk is rendered safe for food purposes and yet, provided that the temperature is not too high, is capable of going through the usual form of fermentation common to raw milk, thereby giving the consumer due notice of any undue age.

Commercial pasteurization, however, is not carried on as a health measure, but purely for business reasons. It is for the interest of the large milk dealer to first preserve the large volume of milk he has on hand which he may desire to hold for a day or two before selling, and second, to distribute a safe milk in order to avoid possible damage suits owing to possible epidemics of disease among his customers. The latter is avoided by the pasteurization of the milk. Undoubtedly, old

milk and milk high in bacteria are pasteurized commercially, and no doubt much pasteurized milk is reinfected with bacteria.



The chart shows the influence of commercial pasteurization upon the bacterial content of milk, the statistics being obtained from the records of the New York City Department of Health. Two sections of the chart show good conditions in the pasteuri-

zation plants, and the third section shows poor conditions caused by contamination of the milk after pasteurization, or high bacterial content before pasteurization. The milk in these instances was degraded. If these conditions occur in supervised supplies they must be very frequent in unsupervised supplies.

The commercial pasteurization of milk should be under official supervision for the following reasons: —

1. To prevent the pasteurization of milk high in bacteria.
2. To prevent the heating of milk to a temperature sufficient to change its chemical composition.
3. To see that the pasteurization is carried out in such a manner that the pathogenic bacteria are killed.
4. To see that the milk is not reinfected after pasteurization.

PART IV. FACTS OF THE PRESENT OFFICIAL SUPERVISION OF THE MILK SUPPLY OF THIS COMMONWEALTH.

A. PRESENT STATUS OF OFFICIAL SUPERVISION OF THE MASSACHUSETTS MILK SUPPLY BY FEDERAL, STATE AND LOCAL AUTHORITIES.

Local Inspection.

Local milk inspection is carried on under the provisions of chapter 405 of the Acts of 1909, which require that the boards of health of all cities *shall*, and the boards of health of towns, or the selectmen acting as such boards, *may*, appoint one or more inspectors of milk for their respective cities and towns. Each inspector shall be sworn before entering upon the performance of his official duties, and shall publish a notice of his appointment for two weeks in a newspaper published in his city or town, or, in the absence of such newspaper, shall post the notice in two or more public places in such city or town. The inspector shall keep an office, and shall record the names and places of business of all persons engaged in the sale of milk within his city or town.

The boards of health may appoint a collector of milk. The inspectors or collectors may enter all places in which milk is stored, and all carriages used for the conveyance of milk, and may take samples for analysis. The inspector of milk shall license the persons engaged in the sale of milk, except producers selling milk to other than consumers or less than 20 quarts per day to consumers.

The statutes prohibit the sale of milk containing added water or any foreign substance, or as pure milk, milk from which the cream or any portion thereof has been removed. Skimmed milk may be sold if labeled as such in uncondensed Gothic type not less than 1 inch in length. The statute also prohibits the sale of milk containing less than 12.15 per cent. total solids, or less than 3.35 per cent. fat. There is a special provision allowing a producer of milk to sell milk below the standard

until twenty days after he has received written notice from the inspector that his milk is below the standard, both in solids and fat. The effect of this statute is to permit the producer to sell milk with total solids as low as 11.70 per cent., because such milk will invariably contain at least 3.35 per cent. fat. This milk cannot be sold by any person except the producer.

Chapter 744 of the Acts of 1914 provides that it is unlawful for any person engaged in the milk business to sell or deliver any milk without first obtaining a permit from the board of health of the city or town where such milk is to be sold. This permit is to be issued only after an inspection, satisfactory to the board, of the premises upon which, and the condition under which, the milk is produced. The boards of health are also permitted under this act to make such reasonable rules and regulations as they may think suitable for protecting the public health. The duty of enforcing this portion of the act has been placed in the hands of inspectors of milk appointed for their respective cities or towns. If the board of health revokes a permit they shall immediately send notice of the fact to the State Department of Health, and the State Department of Health must then notify the boards of health of other cities and towns where this milk is liable to be sold, and any dealer in milk who is liable to sell it, of the action of the local board of health. After receiving such notice from the State Department of Health it is unlawful for any dealer to sell or offer for sale the milk from a dairy the permit of which has been revoked. It is the duty of the State Department of Health to enforce this portion of this law.

A careful study of the provisions of this act will show that if carried out as it should be there would be a needless duplication of inspection on the part of many of our cities and towns. There is scarcely a city or town of any size in this State in which the milk dealers' supply is sold exclusively; for example, the milk sold in Boston is to a large measure sold also in Lynn, Salem, Peabody, Saugus, Melrose, Stoneham, Medford, Malden, Winchester, Arlington, Belmont, Somerville, Revere, Chelsea, Cambridge, Watertown, Waltham, Newton, Brookline, Dedham, Milton and Quincy. The milk sold in

Springfield is to some extent sold also in West Springfield. The milk sold in Hopkinton, Holliston and Hopedale is also sold in Milford. Milk sold in Framingham is also sold in Natick, Wellesley and Sherborn. Nearly the entire milk supply of Methuen is from the same source which supplies the city of Lawrence, and milk dealers supplying Dracut, Chelmsford and Tewksbury also deliver milk in Lowell. Similar conditions exist in other portions of the State, although not to such an extent as in the vicinity of Boston. If this law was enforced as the statute contemplates, each farmer supplying milk to these various milk dealers would be subjected to inspection by the representatives of the boards of health of from 6 to 15 different cities or towns,[1] and in many cases, even with the little enforcement this law has had, producers have been visited by at least three different inspectors and have been asked to comply with three different sets of rules and regulations. Even if the representatives of three or four different cities or towns did not visit the same dairies, the provisions of this act require them to make inspections in the same territory. For example, the milk from dairies situated within 1 mile of each other in the Connecticut valley goes in some instances to Greenfield, in others, to Northampton or to Springfield; and similarly in Cheshire the farmers are selling in some instances to North Adams, and in others to Pittsfield, making it necessary for inspectors of North Adams and Pittsfield to visit the town of Cheshire and examine dairies in that town in order to comply with the provisions of this act. Inasmuch as the provisions of this act have been carried out by but few localities, the needless duplication of inspection with its attending difficulties has been limited.

State Inspection.

State Department of Health.

The State Department of Health is authorized by statute to expend annually a sum not exceeding $17,500 for the enforcement of the laws relative to the adulteration of food and drugs, three-fifths of which sum, or $10,400, shall be spent for the enforcement of the laws relative to the adulteration of milk and milk products. Under the provisions of this act the State

[1] Unless local boards of health made the employees of other boards their agents for dairy inspection.

Department of Health collects and examines milk, butter, cheese, condensed milk, cream and ice cream. If any violations of the law are discovered they are carefully investigated, and, if conditions warrant, prosecutions are made or further investigations started, with a view to prosecuting the responsible offender.

The following list shows the number of samples collected, examined and prosecuted during the past eight years by the State Board of Health.

Year.	Samples collected and examined.							Prosecutions.		
	Milk.	Butter.	Cheese.	Condensed Milk.	Cream.	Ice Cream.	Total.	Milk.	Milk Products.	Total.
1907, . . .	2,992	87	15	19	26	–	3,139	142	5	147
1908, . . .	3,934	54	22	38	170	–	4,218	214	5	219
1909, . . .	4,611	68	22	26	171	2	4,900	171	9	180
1910, . . .	5,396	102	15	23	104	–	5,640	106	13	119
1911, . . .	4,690	30	9	28	166	–	4,923	78	4	82
1912, . . .	4,900	33	6	27	100	–	5,066	64	1	65
1913, . . .	6,702	58	–	8	209	132	7,109	101	5	106
1914, . . .	6,008	27	3	44	284	206	6,572	52	6	58
Totals, . .	39,233	459	92	213	1,230	340	41,567	928	48	1,066

The State Department of Health has no power to make rules and regulations relative to the sanitary conditions of dairies, but dairy inspections have been made under the general provisions of the law creating the State Board of Health. The number of dairies inspected is given in the following table: —

Year.	Number of Dairies inspected.	Year.	Number of Dairies inspected.
1907, ...	2,714	1912, ...	1,451
1908, ...	2,241	1913, ...	4,493
1909, ...	1,771	1914, ...	2,222
1910, ...	2,053	Total, ...	19,004
1911, ...	2,069		

Dairy Bureau.

The Dairy Bureau of the State Department of Agriculture has an annual appropriation of $8,000 for inquiry into the methods of butter and cheese making, and for the enforcement of the laws relating to the sale of adulterated milk and milk products. The Dairy Bureau maintains a general agent whose salary is provided for by a special appropriation, and several other agents who obtain the samples and make the necessary investigations. The chemical work is all done by private chemists, being paid for at contract prices according to the number of samples submitted. The Dairy Bureau does but very little work relating to the adulteration of milk, but spends the largest amount of its appropriation enforcing the laws relative to the sale of oleomargarine. The Dairy Bureau reports that it has made no dairy inspections except those made in connection with the clean milk and other contests.

The following tables show the number of samples of milk and milk products examined by the State Dairy Bureau during the past eight years, and the number of prosecutions for the sale of adulterated milk and milk products.

Samples collected and examined.

Year.	Milk and Cream.	Butter and Oleomargarine.	Cheese.[1]	Condensed Milk.[1]	Ice Cream.	Total Samples.
1907,	192	1,182	–	–	–	1,374
1908,	321	1,497	–	–	–	1,818
1909,	90	1,779	–	–	–	1,869
1910,	136	1,724	–	–	–	1,860
1911,	35	1,282	–	–	–	1,317
1912,	124	2,042	–	–	–	2,166
1913,	94	3,458	–	–	–	3,552
1914,	51	1,816	–	–	–	1,867
Totals,	1,043	14,780	–	–	–	15,823

[1] About 100 analyses of cheese and condensed milk are included with the butter and oleomargarine figures.

Number of Prosecutions.

Year.	Milk.	Cream.	Butter.	Oleomargarine.	Total Prosecutions.
1907,	19	–	72	111	202
1908,	13	1	51	104	169
1909,	5	–	33	168	206
1910,	4	–	77	139	220
1911,	2	–	60	157	219
1912,	6	–	88	122	216
1913,	2	5	54	88	149
1914,	9	–	27	93	129
Totals,	60	6	462	982	1,510

Department of Animal Industry.[1]

The State Department of Animal Industry has charge of the examination of animals with respect to the presence of diseased conditions. The appointment of local inspectors is similar to that pursued in the appointment of inspectors of slaughtering. Nominations of inspectors of animals are made by the boards of selectmen of each city and town, which nominations must be approved by the Commissioner of Animal Industry before the inspector is appointed. The statute provides, under certain conditions, that a portion of the salary of these men may be paid by the State. Inspections by these local inspectors of animals usually take place in the spring.

If upon examination of the animals on a certain premises the inspector has reason to suspect the presence of any contagious disease, such animal or animals are quarantined, and the inspector sends duplicate copies of such quarantines to the office of the Department of Animal Industry. A copy of the report is left with the owner of the animal, another one retained by the inspector, and the full record sent to the office of the Department of Animal Industry. At the time a copy of this record is left with the owner of the premises, such recommendations for improved conditions as may be necessary in the opinion of the inspector are brought to the attention of the

[1] The following résumé of the present status of animal inspection is directly compiled from a statement submitted by Dr. Lestor H. Howard, Commissioner of Animal Industry.

owner by that inspector, and the owner is requested to make such improvements. A later visit is made by the local inspector, at which time, if conditions are found to be decidedly improved, the report submitted to the Department above referred to credits the owner with the conditions found on the second visit, and in most cases it is found that the owners carry out the recommendations made by the inspectors.

As a result, many of the cases that under a former plan would have been called to the attention of the District Agents of the Department of Animal Industry are satisfactorily disposed of locally, but if not so disposed of the District Agent is sent to the premises, the supervision of the Department of Animal Industry is directly given, and frequent visits made until the conditions are satisfactory.

All cattle over six months of age coming into Massachusetts from any point without the State, if not intended for immediate slaughter, are, according to law, tuberculin tested by an agent of the Department of Animal Industry, unless accompanied by a certificate of test made by a man approved by the officials of the State wherein the shipment originates. All animals reacting to this test are destroyed.

Federal Inspection.

The United States Department of Agriculture, Bureau of Chemistry, has supervision over the interstate shipment of food including milk, and over the food introduced into this country from foreign countries. The Bureau of Chemistry has, until recently, taken little action upon the subject of milk. Some years ago Dr. Charles Harrington, then Secretary of the Massachusetts State Board of Health, endeavored to induce Dr. Harvey W. Wiley, then Chief of Bureau of Chemistry, United States Department of Agriculture, to prevent the shipment into this State of milk from dirty dairies in New Hampshire, and this the Department of Agriculture refused to do. Two years ago Mr. Lythgoe endeavored to have the Bureau of Chemistry prevent the shipment of adulterated milk from Rhode Island into Fall River. This the Federal authorities refused to do. The United States Department of Agriculture has authority to absolutely prohibit the importation into this

country of any food product which may be adulterated or misbranded, or the sale of which may be prohibited in the country of its production. Under the provisions of this act the Federal government has recently had an inspector investigating the sanitary condition of dairies and creameries in Quebec. Action taken by the Federal government under this section of the law need not be passed upon by the courts.

The Commissioner of Health of the State of Massachusetts has been made *ex officio* a Federal officer for the enforcement of the United States law relative to food samples shipped for sale into this State, and the analyst of this Department has been made the collaborating chemist of the United States Department of Agriculture. Under the provisions of these appointments the State Department of Health of Massachusetts is able to exercise some control over the interstate shipment of foods, but as a rule the Federal law is difficult of application, and when adulterated milk from near-by cities or towns in other States has been shipped into Massachusetts, this Department has invariably succeeded in finding the producer of the milk in the State, and obtaining samples from him at the time of delivery to the purchaser. The interstate shipments of milk can best be controlled through the agency of the person buying the milk and selling the same in this State.

B. PRESENT STATUS OF LOCAL MILK INSPECTION.

The present statutes regarding local milk inspection were drawn with the contemplation that local inspection should in general be supreme. This is particularly true with reference to the influence of milk upon public health. Cities and towns have power to grant or refuse licenses to milk dealers, to issue or refuse permits to milk dealers or milk producers, and, what is of more importance, have power to make rules and regulations for the violation of which, or a refusal to comply with which, the license or permit may be rendered void by the authority by which it was issued.

In order to ascertain to what extent the local boards of health exercised the authority the State had imposed upon them, a questionnaire and an addressed envelope was sent to all the local boards of health asking for information relative

to the character and amount of milk inspection done, the localities where the dairies supplying milk were situated, the number of dairies from which the town obtained its milk, and a statement of any infectious diseases occurring in the city or town which may have been caused by milk. The analysis of this questionnaire is given elsewhere.

A second set of questions and a stamped envelope was sent two months later to those boards making no reply to the first questions. Four months later a letter was sent to those boards from whom no reply was received, asking whether or not any milk inspection work was done, and the name of the person in charge of the work. This letter brought in a few more responses, and three weeks later another letter was sent to the balance of the cities and towns making no reply, stating that in the absence of a reply it would be assumed that no milk work was done. Up to Dec. 1, 1915, no replies had been received from a number of towns with an aggregate population of about 3,500 people, or 1 per cent. of the total population.

It was desired to obtain more exact figures relative to the work done by local boards of health, and as this would have involved a larger amount of clerical work than the Board felt it could request the local authorities to perform for us, the inspectors and analysts of the Food and Drug Division were sent to different milk inspectors, or agents of local boards of health, requesting permission to copy certain figures from the official records of their respective departments. These local officials showed every courtesy to our investigators, and gave all the information that they possibly could.

A form was filled out for each town visited, and then the investigator copied from the local inspectors' books upon other forms the name and address of each licensed milk dealer, the number of wagons, whether or not the milk was pasteurized, the amount of raw milk sold, the amount of pasteurized milk sold, the name and address of the producers supplying the dealer, and the dates and scores of the dairy inspection made during 1914 and 1915.

A card index of these various producers and dealers has been made, and we have at present a list of the names and addresses of the licensed milk dealers of this State, and the producers

supplying them with milk, except the dealers and producers supplying the city of Boston. A perusal of the cards shows that with but few exceptions there is practically no duplication of inspection, and in many instances no inspection whatsoever. In completing these statistics the varied character of the work done in the different cities and towns has rendered it a difficult task to set forth the results obtained in a clear and concise manner.

It has been found necessary, in order to make a proper comparison of the work done, to divide the cities and towns into sixteen groups according to the character of their inspection work. In most instances it was found necessary to subdivide the towns in a group, for notwithstanding the fact that the character of the work performed entitles these towns to a position in the group, the amount of work performed was very slight in many instances.

It was found that the replies to the questionnaire were in many instances misleading, most of which were in favor of the local boards making the reply. In one instance, however, where the local board stated that no milk inspection work was done, one of our inspectors found a milk inspector in the town doing good work.

The fact that the local milk inspector had no records of dairy inspection does not necessarily imply that his work as regards actual inspection of the dairies is faulty or inefficient. Some of the inspectors have demonstrated to us the fact that their dairy inspection is productive of excellent results, although they make no dairy scores and keep no records of inspection. Many of these inspectors do not have the clerical help necessary to keep records in proper shape, and therefore may consider it futile to make any. In the case of death or resignation of an inspector, however, the department in which he was employed has no records with which to ascertain the amount and character of work performed by the inspector.

Using the 1910 population figures, 645,000 people, or 19 per cent. of the total population, received no protection relative to milk from their local authorities according to their own statement; and if we include the 1 per cent. who have not responded to numerous letters from the Department, the balance of 80

per cent., or 2,680,000, received some protection from their local authorities; 2,102,000, or 63 per cent. of the total population, are protected by some bacteriological work and some dairy inspection, and 1,446,000, or 43 per cent. of the total population, are adequately protected. The city of Boston represents 670,000 people, or 46 per cent. of the population, so protected. Excluding Boston from these figures and recompiling, the results are as follows: 25 per cent. of the population receive no protection, 53 per cent. are protected to some extent by bacteriological examinations and by dairy inspection, and only 28 per cent. are adequately protected. By adequate protection is meant frequent and careful inspection of dairies combined with frequent, reliable and thorough bacteriological examinations of milk.

Qualifications of Local Milk Inspectors.

While no attempt has been made to accurately summarize the qualifications of local milk inspectors, contact with the different men has given quite an insight into their ability. These men range from those of the highest ability to those of very little ability. Some of them are physicians, some are chemists, some are pharmacists, some are veterinarians, some are men familiar with the production and sale of milk, and some are laymen. Many of these men are qualified only to grant licenses, others with more ability specialize in dairy inspection, and have materially improved the conditions under which the local milk supply is produced and handled. Others add chemical analyses to their work, and still others do bacteriological work, and in general this work is performed in a creditable manner.

Some without the necessary qualifications attempt to carry out complex analytical operations, and in some cases may have instituted prosecutions upon incorrect analyses. One such instance was brought to the attention of the State Department of Health. The local inspector in this instance asked for information relative to the determination of nitrogen in milk by the Kjeldahl process, upon which determination he had based a prosecution. This inspector desired to inform himself concerning the process in order to be able to answer any questions

which might be put to him upon cross-examination. During the course of the conversation, it developed that the inspector had standardized his acid solution against a known weight of sodium hydroxide, which is never sufficiently pure for this purpose. Under these circumstances there might have been a possible error as high as 20 per cent. in the determination. The inspector in this instance was given a correct method of standardization, and found that the error was not sufficient to change his conclusions of the character of the sample.

In many instances the laymen among the local inspectors have developed unusual skill in the analysis of milk, and have become efficient and valuable public servants notwithstanding their scientific and technical limitations. In the country districts the inspector is generally a farmer with the viewpoint of the producer who is selling his products. In the city the inspector is generally a consumer with the viewpoint of the man who is buying milk. When these two classes of inspectors come in contact with each other by working in the same territory there develops a material difference of opinion. An example of this was shown in the reports of inspections made in one town received from two such inspectors. The local man had inspected all the dairies, and in his opinion they were in proper shape to produce milk for sale anywhere. The inspector of a city many miles away where the milk was sold inspected the same dairies and excluded the milk of about 25 per cent. of them on account of dirty premises and unsanitary conditions of production and handling.

The salaries paid to these local inspectors are, on the whole, inconsistent with the necessary qualifications for the positions. Communities should realize that unless they pay the price they cannot get the services of competent men, even if in some instances competent men are serving as local inspectors of milk without adequate compensation.

C. DISCUSSION OF PRESENT SYSTEM OF DAIRY INSPECTION AND ITS SANITARY VALUE.

The system of dairy inspection carried on at present in this country is that outlined by the United States or some similar dairy score card, although the former is the one which is most

used for the reason of uniformity in comparison. This score card allows a total of 40 per cent. for equipment and a total of 60 per cent. for methods. Under methods 8 per cent. is allowed for cleanliness of the cows, 6 per cent. for cleanliness of the stable, 8 per cent. for cleanliness of the utensils, 9 per cent. for cleanliness during milking, and 16 per cent. for the cleanliness and care in handling of the milk. Under equipment 6 per cent. is allowed for the health of the cattle, 6 per cent. for the location and construction of the stable, 11 per cent. for light and ventilation, 9 per cent. for construction and character of utensils, and 6 per cent. for the milk house. It is a well-known fact that clean milk can be produced in dirty stables, provided that the milker is a clean man and cow has been thoroughly cleaned before milking, but under ordinary circumstances milk obtained from dirty cattle housed in dirty stables is liable to be dirty milk. This score card has been severely criticized on the grounds that too much stress is laid upon equipment and too little on methods.

A questionnaire was sent to the various food commissioners of the different States early in the present year asking, among other questions, whether or not the United States score card was of any practical value in improving dairy conditions, and what changes it would be advisable to make in order to improve the card. Twenty-four replies were received, all answering the first portion of the question in the affirmative. To the second portion of the question three persons suggested that no change need be made, but 11 others suggested changes, the majority of which were to the effect that more value should be given to methods and less to equipment. The character of the replies were very characteristic of the personnel of the various departments. For example, replies from health boards only stated that more stress should be placed upon cleanliness of attendants, health of cattle and medical inspection of attendants. One, a director and chemist of an experiment station, replied that the dairy inspections should be supplemented by chemical and bacteriological examinations of the milk and the water.

It is evident by the replies received from these various food commissioners that the score card has in their opinion resulted

in improved dairy conditions. It is undeniably true that if dairy conditions are improved dairy products must of necessity be improved.

Because of the facts that an exceptionally clean man can produce clean milk in a dirty stable, and a dirty man cannot produce clean milk even in a clean stable, certain opponents of inspection of dairies or of other forms of inspection directed towards farmers seem to advocate the theory that the proper way to produce good, clean milk is to have dirty stables as the first requisite. The consumer, however, is now demanding that the factories in which his food is prepared, warehouses in which it is kept, and the stores in which it is sold, shall be clean. The consumer is now demanding that the dairies from which his milk is produced shall be clean, but if he is educated to the belief that producers of milk need not keep their premises clean, the consumer is liable to abstain from the use of milk, and the dairyman loses his market.

The score card, however, is of the highest educational value to the farmer by pointing out the measures for producing clean milk upon old premises. If a dairy farm scores very low, and the farmer desires to produce a better article, or if he is paid a higher price for a better article, he can easily improve the score, and consequently the character of the milk, by improving the methods and to a slight extent the equipment.

The purchase of a small-top milk pail increases the score by 5 per cent., washing and wiping the udders before milking increases this portion of the score to 6 per cent., removing the milk immediately from the stable without pouring from the pail adds 2 per cent., cooling immediately after milking adds 2 per cent. more, and cooling, storing and transporting below 50° F. adds 10 per cent. to the score. This procedure increases the total score by 25 per cent., and if the stable was dirty and the cows were not tuberculin tested the dairyman by remedying the defects may add 11 per cent. more to the score, and by building and equipping a milk room and keeping it clean may add 5 per cent. more to the score. Thus it is apparent that if this portion of the score card is lived up to both the quality of the milk and the score of the dairy will be improved.

In order to see whether or not there was any uniformity in

the dairy scores in different parts of the country, and to ascertain the mathematical difference between a clean and a dirty dairy, the scores obtained by the Milk Board upon their various trips were taken, computations made, and the computations plotted in such a manner that the various scores of different portions of the score card could be made comparable with each other. It was found that as a general rule the dairies scored relatively higher in methods than they did in equipment, showing that the dairymen appreciated the value of good methods in improving the product. It was found, however, that those dairies supplying milk to the "contractors" were not in such good condition as those located near and sending milk to large cities. The scores of 117 dairies supplying near-by cities, and the scores of 124 dairies supplying contractors, were separately combined and plotted, the resulting plot showing that the contractor's dairies were somewhat inferior to those supplying milk to near-by cities. This was particularly noticeable in that portion of the score relative to cleanliness of stable. Thirty-five per cent. of the contractor's dairies scored 0 for cleanliness of the stable, and 15 per cent. scored only 1.3 per cent. Of the dairies supplying near-by cities none scored 0 for cleanliness of stable, and only 8 per cent. scored as low as 1.2 per cent. Fifty-eight per cent. of the dairies supplying near-by cities scored 3.5 per cent. on cleanliness of stable, but only 15 per cent. of the contractor's dairies reached this score. The systematic inspection on the part of agents of local boards has had an influence upon those dairies located near their respective cities and towns, resulting in improved conditions at the dairies. These conditions are due to the fact that if the farmer is paid a sufficient price to make it profitable to purchase good utensils and to keep his stable clean he will do so. The farmers supplying milk to the large contractors receive on an average from 1.5 to 2 cents less per quart than the farmer selling to a dealer delivering milk in a near-by city, and, therefore, cannot afford to take the care of the milk and the stable that the dairyman does who receives more money.

Dairy inspection is of value in increasing the sanitary quality of milk in those communities where it is rigidly enforced, and particularly so where milk is sold upon its sanitary value. It,

however, should be almost entirely educational, because it is the milk and not the stable which is consumed, and, therefore, the inspection and the improvement of the milk rather than the stable should be the prime object. There is no doubt, however, that the dairy inspection which has been carried on in this State for the past eight years has resulted in an improvement of dairy conditions and of the milk supply, and for this reason dairy inspection is highly desirable.

PART V. THE RELATIONSHIP BETWEEN COW'S MILK AND THE PUBLIC HEALTH.

A. INTRODUCTION.

The enormously diversified individual conditions under which cow's milk becomes an important factor in human health or disease may be reduced to three great groups: —

I. The relationship between the use of cow's milk, or milk products, and certain infectious diseases of man.

II. The relationship between the use of cow's milk as a substitute for human milk and the death rate of infants.

III. The relationship between the use of cow's milk, milk products and derivatives, and the sustaining of that balance of the processes of destruction and repair within the human body that is commonly known as a state of health, or, in other words, the relationship of milk to human nutrition, or the metabolism of milk.

The first two of these groups have one common ground in contrast to the third. They represent the health-menacing possibilities of milk. The last represents the health and life sustaining properties of milk as an everyday article of diet.

Perhaps the most unfortunate thing about the entire literature of milk — about the present agitation relative to the use of cow's milk throughout the country — is the slight amount of emphasis that has been placed on the value of milk as contrasted to the dangers of milk as an everyday article of human diet.

Milk as an incubator of infections, the limitations of the cow as a substitute for the human mother, the connection between dirty, stale and decomposed cow's milk and the summer scourge of the innocents, — all these themes have been worn threadbare, all have been argued to the point of exhaustion, and all more or less conclusively proved. But the beneficent rôle played by the maligned cow even under the most adverse conditions, in stepping into the breach between life and death when mothers fail, has received all too scanty emphasis.

It may even be seriously questioned whether some of the well-intentioned popular agitation, relative to the disease-bearing possibilities of milk, has done as much *service* to the cause of humanity, by pointing out the existence and insisting upon the correcting of certain very real and serious dangers, as they have done *injury* to that cause by inducing an exaggerated fear of cow's milk as it is produced and handled at present. This fear, in turn, has led to attempts to substitute for cow's milk other materials and products that in the long run are vastly more inimical to human health in general, and to that portion of humanity designated as infancy in particular.

It may be held that such statements as the foregoing are damaging to the "clean and safe milk" cause; that any responsible officials making such statements are placing themselves in the position of apologists for the cause of dirty and disease-producing milk. Far from it. Such statements simply indicate that the other side of the problem should receive its fair consideration.

In the United States during the past thirty years it has become firmly established by law and by the general consensus of public opinion that the business of producing and distributing cow's milk has such extensive and direct relations to the public health and welfare that it is justifiable, through an exercise of that police power which resides in all organized government, to interfere with the commercial processes of that business to an extent that is hardly approached in any other line of commercial enterprise. In direct proportion to the growth of such sentiment — permitting, even demanding, this extraordinary interference in the name of the public health with a legitimate life-supporting industry — it becomes more and more important that this police power be exercised with sanity, discrimination and fairness to all concerned.

Exaggeration of the dangers of milk as they are, and an insistence upon non-essential, whimsical, illogical and excessively costly measures of alleged protection of the consumer's milk at the present, are never going to successfully solve the problem of safe, clean and honest milk for the consumers in the future.

Perhaps there is no service in relation to the milk question that is needed so much to-day as a clear, unbiased statement

of the relative evils and benefits of cow's milk to the human race as conditions are at present.

With this clearly fixed, with the excessive overstatements of present dangers and the moral responsibility of the deliberately dirty or careless producer, dealer and consumer equally clearly understood, the public, who is the final arbiter in the whole matter, can more clearly and intelligently fix and determine, through its representatives and duly authorized agents, the degree of refinement of methods that it considers reasonable and essential for its own best interests, and the price that it is willing to pay to institute such minimum standards of quality as it may determine upon as necessary in the interests of the public health and welfare.

B. MILK AND THE COMMUNICABLE DISEASES.

The more important diseases of man that milk may play an important rôle in transmitting are tuberculosis, diphtheria, scarlet fever, typhoid fever and septic sore throat.

The question as to the connection between milk supply and the transmission of these diseases under certain circumstances is no longer open to debate. It has been proved beyond reasonable doubt. The phases of the problem that are still open to discussion are (*a*) how great a *relative* danger in the transmission of these diseases is milk as at present produced, and (*b*) what are the most reasonable, efficient and economical protective measures that can be adopted to reduce the risk of such disease transmission through milk to a minimum?

1. Milk and Tuberculosis.

Broadly speaking, among the various human diseases that may be transmitted by infected milk tuberculosis occupies a unique position. This is due to the fact that in all the other important milk-borne diseases the infective agency is human, and comes into play after the milk has been drawn from the cow. In the transmission of tuberculosis it is possible that subsequent accidental infection of milk and milk products, due to human tubercle bacilli, may occur, but the great source of danger as regards tuberculosis transmission through milk is *the cow herself.*

So much confusion still exists relative to the connection between animal and human tuberculosis, due to the great controversy that raged in regard to it from 1901 to 1911, that although the questions at issue are now definitely settled, it is perhaps advisable to refer to them briefly in order to make our present problem perfectly clear. This seems the more desirable in the present report from the fact that your Board has found several among the milk producers of this Commonwealth who are under the serious misapprehension that good scientific authorities still deny the transmission of tuberculosis through milk.

Following the demonstration of the tubercle bacillus in 1882 by Koch, it was taken for granted by all the scientific world that the two diseases, human and bovine, were identical, and readily and mutually transferable. His later discovery of tuberculin in 1890, and its rapid application to dairy animals for diagnostic purposes, quickly demonstrated that tuberculosis was more prevalent among dairy animals than had been previously suspected. This discovery led to a veritable epidemic of sanitary live-stock legislation directed against tuberculosis in cattle, which spread over nearly all civilized countries during the 90's. Prominent among such laws were the "tuberculin testing and slaughter of reactors" laws of Massachusetts.

Meanwhile, in 1896, Prof. Theobald Smith demonstrated that the human and bovine types of the tubercle bacillus were not identical, but possessed quite distinctive differences both in appearance, in reactions on culture, and in their relative virulence to different animals when injected experimentally.

In 1901 Koch read his famous paper in London, in which he clearly gave the impression to all the world that there was no relationship whatever between human and bovine tuberculosis. It is not true, as has been often alleged, especially by some who have sought to minimize or deny all relationship between human and bovine tuberculosis, that Koch said that the bovine bacillus and the human bacillus were two different germs. He simply said they were two types of the same species, a point Prof. Theobald Smith had long before made clear. But he did state very emphatically his opinion that the two had little in common. To quote the words of Professor Welch of Johns Hopkins, "Koch certainly left the impression by the conclu-

sions drawn from his own words that there was practically no danger whatever of infection from bovine sources; Koch drew that inference without basis of facts."

The controversy that this opinion of Koch's immediately aroused and the great practical importance of the subject precipitated one of the most intense investigations into the true nature of any communicable disease that has ever been known. The British government appointed a Royal Commission which worked continuously for ten years upon the subject. The German government appointed a similar commission, and these two commissions and other investigators the world over, especially those of the New York City Health Department in this country, carried on researches for years into every conceivable phase of the great problem.

These researches all came to one general conclusion, which can perhaps best be stated in the words of the British Royal Commission in their final report in 1911. The following questions were submitted to them for investigation: —

Question 1. — As to whether the disease in animals and man is one and the same.

Conclusion. — Whether one prefers to regard bovine tuberculosis and the cases of tuberculosis in man, which are caused by *the human type of bacilli*, as varieties of the same disease or as independent diseases, there can be no question that human tuberculosis is in part *identical* with bovine tuberculosis. Our researches have proved that in a considerable proportion of cases of the human disease the lesions contain, and are caused by, bacilli which in every respect are identical with the bacilli which are the cause of tuberculosis in cattle. In all such cases, therefore, the (human) disease is the same disease as bovine tuberculosis.

Question 2. — Whether animals and man can be reciprocally infected.

Conclusion. — We must conclude that mammals and man can be reciprocally infected with the disease tuberculosis.

Question 3. — Under what conditions, if at all, the transmission of tuberculosis from animals to man takes place, and what are the circumstances favorable or unfavorable to such transmission.

Conclusion. — Whatever may be the animal source of tuberculosis in adolescents and in adults, there can be no doubt that a considerable proportion of the tuberculosis affecting children is of bovine origin.

And again: —

It may be asked in what way are children . . . most likely to obtain a large and fatally infective dose of tubercle bacilli? . . . To this question

there can be but one answer, namely, that . . . a considerable amount of the tuberculosis of childhood is to be ascribed to infection with bacilli of the bovine type *transmitted to children in meals consisting largely of the milk of the cow.*

The fact of the existence of bovine tuberculosis infection in human beings once demonstrated, the all-important question from the standpoint of practical safeguarding of the milk supply of any nation, State or community is, how great a danger, how great a menace to human life is this transmission of bovine tubercle bacilli to man? And what are the most logical steps to be taken to minimize or entirely eradicate this danger?

From the careful and extensive investigations of Park and Krumwiede, of the New York City Health Department, it would appear that at least one-third of all cases of tuberculosis in children under five years of age are due to bovine bacilli, and nearly as great a proportion in cases occurring in children between five and fifteen years of age.

It would also appear that the bovine type of bacillus is practically never found in adult pulmonary tuberculosis or consumption, but this does not necessarily mean that infection in childhood by the bovine tubercle bacillus has no relation to the occurrence of adult consumption.

When consumption is excluded, the percentage of adult tuberculosis due to the bovine tuberculosis in the large series of cases so exhaustively investigated rises to 7.3 per cent. Various leading authorities, American and foreign, are in substantial agreement that at least 5 to 7 per cent. of tuberculosis in human beings is definitely and directly of bovine origin. And the possibility of the true percentage being still higher cannot be denied.

In addition to these well-demonstrated dangers to the human race from tuberculous milk, two other theories have been advanced and have received very serious attention from the world's best authorities on tuberculosis.

The first theory is based on the fact that after all, the *differences* between the human and the bovine tubercle bacillus are merely differences of type or of degree. They cannot be considered as distinct, fixed species. Or, to use the apt illustration of Professor Ravenel, the differences between human

tubercle bacilli and bovine tubercle bacilli are analogous to the differences between a Jersey cow and a Holstein cow, rather than to the differences between a cow and a horse. With this admitted, it is entirely conceivable that bovine bacilli might be taken into the body in childhood, and after a lapse of years, by spontaneous breeding in human tissues, finally take on the essential characteristics of the human bacillus in much the same manner as a farmer may greatly change the characteristics of his final product in any field crop by seed selection extended over a period of years, without introducing any outside seed. If this does actually occur, if bovine bacilli, taken into the child's body through milk, under the influence of a human environment, in the course of many, many generations of germ life, approach the human bacillus type, and finally become manifest as active tuberculosis in the adult, then, the bacilli recovered showing human characteristics, the infection would naturally be ascribed to human origin although in reality bovine. There are some facts that tend to support this view, but the majority of authorities are not inclined to believe in it, although no one can yet positively deny its correctness.

The other theory has received much more favorable consideration, and it is perhaps not putting it too strongly to say that certain of its originally assumed conditions are beginning to be quite firmly established as facts. Without going into details that would be entirely out of place here, it is enough to say that the fundamental concept of this view is simply that certain infections with bovine tubercle bacilli in early childhood, which at the time cause very slight or no visible constitutional symptoms, may be an important factor in the development of tuberculosis later in life by rendering the person less resistant to heavy doses of the human bacilli than he would otherwise have been.

Other points of great significance in the relationship of milk to tuberculosis are: how many of our dairy cows are tuberculous; which ones among the tuberculous animals are dangerous to the consumer of raw milk; and how relatively frequent is the occurrence of bovine tubercle bacilli in ordinary market milk, cream, butter, etc.

A complete discussion of the first point would take us too far into the field of veterinary medicine. Suffice it to say that while absolutely reliable figures for all the dairy cattle of any nation or State do not exist, such authorities as Chief Melvin of the Federal Bureau of Animal Industry and Professor Moore of Cornell concur in the opinion that not less than 10 per cent. of the dairy cows of the United States are affected with bovine tuberculosis. M'Fadyean, an eminent British authority, estimates that 30 per cent. of British cows are tuberculous. In Massachusetts over a period of fifteen years, from 1893 to 1908, out of a total of 86,223 animals tested, 11,853 reacted to the tuberculin test for tuberculosis, 10,760 of them were slaughtered and 10,688, or 99.34 per cent., were found definitely tuberculous at post-mortem examination. It is interesting to note that although comparatively few examinations are being made at present in this State, it seems to be quite a universal opinion among the older milk producers interviewed that bovine tuberculosis is relatively much less frequent among the Massachusetts dairy cows than was the case twenty years ago.

These figures are enough to show the great extent of the disease tuberculosis among dairy cattle.

The evidence is now complete showing that tubercle bacilli are excreted in large numbers in the dung of tuberculous cows, and that this occurs even when there is no lesion of the animal's intestines.

It is also quite universally agreed that at least 2 per cent. of tuberculous cows suffer from tuberculosis of the udder. In this disease prodigious quantities of bovine tubercle bacilli pass directly into the milk with every milking, but under present conditions it is more than likely that even more tubercle bacilli in the aggregate pass into the milk from the dried dung of the tuberculous animals.

Two or three other points bearing upon the same subject are of great practical significance.

(*a*) That the clinical diagnosis of tuberculosis in cows is recognized as impracticable in all except the well-marked cases.

(*b*) That extremely small amounts of milk from cows suffering from udder tuberculosis are sufficient to produce tuber-

culosis experimentally in animals when administered by inoculation.

(*c*) That tuberculosis can be induced with varying degrees of readiness in various animals by feeding tuberculous milk (*i.e.*, milk from cows suffering from tuberculosis of the udder), and, what is more significant, in none of the considerable series of animals so tested by the British Royal Commission did this occur more readily than in the anthropoid apes, their relative susceptibility being much higher than that of calves.

(*d*) That samples of unselected raw market milk taken at random from the city milk supplies of many European and American cities have been proved by the work of many investigators to contain virulent bovine tubercle bacilli in from 2 to 50 per cent. of samples taken, with an average of between 10 and 20 per cent. probably predominating.

Without going into any details, it is obvious that there are only two conceivable general lines of action that will be practicable in coping with the problem of minimizing or eradicating the danger of bovine tuberculosis to the human race. They are either the practical extermination of bovine tuberculosis, or such universal treatment of cow's milk as would render it safe and inocuous from the standpoint of transmitting tuberculosis, even though it may originally have contained more or less tubercle bacilli. As a practical procedure it is, of course, necessary that both lines of action be followed.

The struggle against bovine tuberculosis among dairy herds is a subject that does not strictly pertain to this report, interesting though it would be to review some of its more salient features. It must be admitted that up to the present time the total progress in this line, while by no means negligible, cannot be considered as sufficient to give us any sound basis upon which to base any hope of eliminating the menace of bovine tuberculosis by this means in the near future. Certain important subsidiary measures should never be neglected, such as careful veterinary inspection of herds to rule out tuberculosis of the udder, and insistence upon such standards of dairy cleanliness in general, and of clean methods of milking in particular, as will guarantee a minimum possibility of tubercle-infected dung finding its way into the milk. But the

surest, most economical and quickest method that has ever yet been devised to bring about the end in view, namely, the perfect safeguarding of the milk supply as regards bovine tuberculosis, is through the resort to the process of pasteurization. Pasteurization in its relation to communicable diseases in general will be considered later. It is sufficient to make the definite, emphatic statement here that pasteurization properly performed will undoubtedly remove all danger of transmission of tuberculosis through milk.

2. Methods of Infection of Milk by Diphtheria, Scarlet Fever, Septic Sore Throat and Typhoid Fever.

That milk is a most favorable medium for the growth of specific organisms of certain infectious diseases of man has been demonstrated by Eyre. He found that typhoid bacilli were multiplied in healthy cow's milk 6,000 times in twenty-four hours, while diphtheria bacilli increased more than 1,000 times during the same period. However, this experimental work was done upon milk obtained under sterile conditions. Your Board has not found any reliable data upon the amount or rate of increase of pathogenic bacteria in unsterilized milk under ordinary conditions of temperature. It can be readily seen that in the presence of the many non-virulent types of bacilli found practically universally in raw milk, the question of determining just how rapidly growth of disease-producing bacteria occurs is practically insoluble. The presence of acid-forming bacteria in milk checks their growth, but cannot be relied upon to kill any contained typhoid bacilli (Savage). Their viability has been determined by Hesse and Field, who found the typhoid bacilli to survive as long as four months in sterilized milk. It is, therefore, readily seen how small particles of infection conveyed to milk may infect large supplies in the mixing and handling, and in turn may infect susceptible individuals who drink the raw milk. Of the infection of milk from human sources there is now abundant evidence. Rosenau writes that "the more serious infections in milk come from human origin." It may be conveyed directly or indirectly. Typhoid infection may be conveyed directly to the milk by the person taking care of the patient, whose other duties, after taking care of the patient

and handling soiled bed linen, include the care and handling of milk. A source determined in recent years to be quite common is the carrier or person who shows no symptoms of the disease, but whose excreta contain the infection. These findings have been duplicated so many times now as to become commonplace. Twice in this State during the present year has the same point been completely determined, — in one instance in a carrier who had the disease five years previous, and in the other in a carrier who had the disease at least thirty-five years previous. Lumsden and Woodward cite an instance of a woman milker on a dairy who had typhoid fever eighteen years before the outbreak which was attributed to her. Typhoid bacilli were found in large numbers in her feces. No other source could be found to account for the infection in the milk.

Still another source of direct infection comes from the convalescent whose feces and urine still contain the bacilli, and who is not sufficiently isolated from the milkers or others handling milk.

Indirectly, typhoid infection may get into the milk through the medium of sewage-polluted water used for washing the milk utensils, or by fraudulently adulterating the milk with specifically polluted water.

Diphtheria infection of milk most usually occurs directly from persons engaged in milk production or in the handling of milk while suffering with a mild or unrecognized form of the disease; or by persons similarly employed who show no symptoms of the disease, but who carry the bacteria in the nose and throat; or by such persons coming in contact with milkers or others handling milk. Bacteriology now plays an important rôle in the discovery of milk-borne epidemics. Outbreaks have occurred where persons employed as milkers, upon bacteriological examinations have shown the presence of virulent diphtheria bacilli in their throats. Klein, through experiments, has tried to show the possibility of bovine diphtheria, but practically all the present-day authorities hold that there is no evidence that the diphtheria bacillus is ever of bovine origin. That teat ulcers may be secondarily infected with diphtheria bacillus by milkers has been demonstrated. Dean and Todd in 1902 described a small outbreak in which diphtheria bacilli were isolated from the teat lesions and from the milk.

Through human channels the virus of scarlet fever may be introduced into the milk in similar ways to that of diphtheria. The usual way is from an unrecognized case coming in contact directly or indirectly with the milk supply. Harrington records an extensive outbreak as being caused by a man employed to taste milk, who used the same spoon in sampling each lot of milk. The daughter of this man was found to be desquamating, and he himself showed symptoms of the disease. The possibility of bovine infection with scarlet fever has been studied by Klein in connection with the Hendon outbreak of 1885, and while his views were favorable, they have been strongly opposed by other observers. Rosenau states that "Cows do not have typhoid fever, diphtheria or scarlet fever."

As to the possibility of bovine streptococcus infection being the cause of septic conditions in the throat of man, Theobald Smith states, "There is at present no satisfactory evidence that bovine streptococci associated with mastitis or garget are the agents of tonsillitis in man." From the results of certain experiments conducted by Savage, it is suggested that under ordinary conditions bovine streptococcus mastitis is not a cause of human disease. Rosenau says, "It is assumed that the infection usually gets into the milk from human sources, although it is suspected that streptococci eliminated by diseased udders may be responsible for some outbreaks." Milk-borne outbreaks of septic sore throat in this country, after careful investigation, have failed to disclose any disease of cows sufficient to account for the infection.

3. Communicable Diseases of Minor Significance or Relative Infrequency, in which Milk is concerned as an Agent of Transmission.

Although there are several other communicable diseases which are transmitted through the medium of infected milk, tuberculosis, diphtheria, scarlet fever, typhoid fever and septic sore throat comprise all the communicable diseases of man, in whose transmission cow's milk ever becomes an important factor, that are of any practical importance in the State of Massachusetts.

4. The Evidence available as to the Relative Importance of Milk as a Means of Transmission of Communicable Diseases, as compared with Other Means of Transmission.

Incidental reference has already been made to this part of the public health problem of milk in considering the individual diseases, but certain generalizations on this point are needed to make the exact status of the problem clear.

One point, and only one point, can be considered as settled, viz., that cow's milk from either animal (*e.g.* in tuberculosis) or human (*e.g.* in typhoid) sources may, and more or less frequently does, become infected, and thereby under certain conditions subsequently becomes the causative factor in the transmission of such diseases to man. But the all-important question in this connection at once arises as to just how great a source of danger milk is in this respect under our present conditions.

It is not very flattering to the present condition of American epidemiology to be obliged to report that it is impossible to give even a roughly approximate estimate upon this extremely important and practical point.

One point that needs to be firmly kept in mind is that practically all of our present information, with one or two notable exceptions, relates to milk as a disease factor *under epidemic conditions only.* No State in the United States makes a sufficiently careful study of its communicable diseases to give a reliable basis upon which to form any opinion in regard to the relative importance of infected milk in the occurrence of the so-called sporadic or isolated or endemic cases of typhoid, diphtheria or scarlet fever.

Tuberculosis is a disease that is never epidemic; in all circumstances it must be regarded as of sporadic or endemic origin. The reasons why as yet it is impossible to state with any degree of certainty the possible maximum effect of tubercle bacilli infected milk upon the prevalence of human tuberculosis have already been explained. But all of the other serious communicable diseases of man that, so far as we know, are in part spread through infected milk occur in both epidemic and endemic or sporadic form.

Looking at the problem of the relation of milk to the public health in its entirety, in order to give it its proper weight and

proportion compared to other health problems, it is highly desirable to know just how great a factor in both the epidemic and endemic occurrence of typhoid, scarlet fever, diphtheria and septic sore throat infected milk actually is. Obviously, if it were possible to prove, or even if it were possible to deduce strong presumptive evidence to indicate that milk infection is a 75 per cent. factor in the total incidence of these diseases, then our obligations to the public health would justify, even demand, the advocating of prophylactic measures much more drastic and expensive than would be indicated if, on the contrary, infected milk could only be demonstrated to be responsible for 1 or 2 per cent. of the total incidence of these same diseases.

In the one instance almost any expense and stringency of sanitary regulations could be justified, for by their vigorous application there would be every opportunity to rapidly decrease the prevalence of these diseases to such an extent as to render their total suppression a reasonable prospect in the immediate future.

In the other instance there would be no such justification from a public health standpoint. To make the point clear, let it be assumed that it had been proved that only 1 per cent. each of the total number of cases of typhoid, diphtheria and scarlet fever were due to infected milk; obviously, under such conditions, the expenditure of enough money and energy to totally eradicate milk as a source of infection, while a desirable object in itself, would have a scarcely appreciable effect upon the general typhoid, diphtheria and scarlet fever problem, and it is highly probable that the same amount of money and energy directed against other angles of the typhoid, diphtheria or scarlet fever problem might bring incomparably greater results in decreasing their prevalence.

Because of the great practical importance of these factors your Board has endeavored diligently to ascertain what, if any, reliable data could be obtained upon this point, both within the Commonwealth and elsewhere. The total information obtained is exceedingly incomplete, but perhaps throws some light on the problem.

(1) Evidence as to the Relative Importance of Milk Infection in the Transmission of Certain Communicable Diseases of Man based on their Occurrence in Epidemics.

It has become quite the fashion of late years among writers in discussing milk to remark that the importance of milk in connection with typhoid, scarlet fever, etc., has been until very recently underestimated. Your Board feels that it is perhaps not out of place to suggest the possibility that in the past four or five years at least this tendency has been reversed, and that to-day there is a strong tendency to overestimate the quantitative relationship of milk to the prevalence of these epidemic diseases.

An interesting example of this probably unconscious tendency is the following: In 1907 it was reported that out of a total of 18 outbreaks of typhoid fever investigated during the two years immediately preceding by the Massachusetts State Board of Health, 14, or 77 per cent., were due to infected milk. In the years 1910–14 (inclusive) the same Board investigated a total of 86 outbreaks of typhoid, which were all that came to the attention of the Board, and presumably represent practically 100 per cent. of all epidemics or outbreaks of any consequence occurring in the State, but found only 31, or 36.4 per cent., due to infected milk. Apparently, either the conditions of the milk supply of the Commonwealth have greatly improved in this respect, or two years did not cover enough time to give a fair average, or, as is more likely, in the earlier series too much emphasis was placed upon the investigation of outbreaks that were suspiciously indicative of milk infection from the start.

It is very easy to pile well-proven epidemic on well-proven epidemic to demonstrate that milk *does* transmit epidemic diseases. As far back as 1908 Trask was able to collect 493 epidemics of typhoid, diphtheria and scarlet fever in which the evidence was conclusive that the cause was infected milk. An enormous number of similar outbreaks have been reported since, ample to prove that the danger of milk transmission is serious and real; but epidemics do not tell the entire story. Although epidemics furnish the spectacular element in communicable dis-

ease work, their total percentage importance is not to be compared with that of the sporadic cases.

Out of a total of 240 epidemics and outbreaks of typhoid, scarlet fever, diphtheria and septic sore throat, *due to all causes*, investigated by the State Board of Health of Massachusetts during the years 1910 to 1914, the total number of cases given by the investigators is 3,198. But in some instances no statement as to the total number can be made, and in many more instances a number is given with the qualification that the number is incomplete. Even if we assume that there actually were as many more cases attributable to these outbreaks as are given, the total number would not greatly exceed 6,000. But in the same years a total of 85,958 cases of these same diseases were reported. Since, during these years, practically every disease outbreak of any material proportions in the Commonwealth has been the subject of a special investigation by the State health authorities, and not over 6,000 cases, at an outside estimate, can be attributed to these outbreaks, it would follow that the endemic prevalence of these diseases is in the aggregate of vastly greater public health significance than the more spectacular epidemic prevalence, — in this instance at least fourteen times as great.

The following tabular comparisons based on Massachusetts investigations are of interest in this connection: —

Summary of Epidemiological Investigations by the State Inspectors of Health of Massachusetts for the Five-year Period, 1910–14, inclusive, with Reference to Frequency of Milk Transmission.

(1) *Diphtheria.*

Year.	Number of Epidemics.	Due to Milk.	Due to Other Causes.	Percentage Milk-borne.
1910,	4	–	4	–
1911,	13	1	12	7.7
1912,	9	1	8	11.0
1913,	9	–	9	–
1914,	26	–	26	–
Totals,	61	2	59	3.2

Summary of Epidemiological Investigations by the State Inspectors of Health of Massachusetts for the Five-year Period, 1910–14, inclusive, with Reference to Frequency of Milk Transmission — Concluded.

(2) *Septic Sore Throat.*

Year.	Number of Epidemics.	Due to Milk.	Due to Other Causes.	Percentage Milk-borne.
1910,	–	–	–	–
1911,	1	1	–	100
1912,	–	–	–	–
1913,	3	2	1	66
1914,	2	1	1	50
Totals,	6	4	2	66

(3) *Scarlet Fever.*

1910,	11	1	10	9.0
1911,	10	1	9	10.0
1912,	8	2	6	25.0
1913,	23	1	22	4.3
1914,	35	2	33	6.0
Totals,	87	7	80	8.0

(4) *Typhoid Fever.*

1910,	15	10	5	66.6
1911,	11	2	9	18.2
1912,	6	3	3	50.0
1913,	31	8	23	25.8
1914,	23	10	13	43.5
Totals,	86	33	53	38.4
Grand totals, all epidemics,	240	46	194	19.2

In the above tabulation the incidence of more than one case in different families in the same locality at the same time is classed as an epidemic or an outbreak, with the natural effect that, with three or four exceptions, the average number of cases per epidemic is small. There have been many small outbreaks where no suspicion has been raised relative to the milk supply that have been handled wholly by local authorities, and

concerning which no epidemiological information is recorded in the State Department of Health. This fact does not invalidate the significance of this table, because for several years past it has been the fixed policy of the Department (Board) to investigate every case of contagious disease reported from a milk-producing farm, as well as every outbreak whether in a large or small community where milk was at all under suspicion. Therefore a fuller table would only tend to lessen the percentage of milk-borne epidemics.

In the same connection it is interesting to note that in the five years 55 other investigations were made by the State Health Inspectors in instances when a *single* case of contagious disease was reported from a milk-producing farm; and precautions ordered and observed, with no secondary cases of any nature subsequently occurring.

In 1910 sworn testimony was given by Prof. C. E. A. Winslow before the milk investigating committee of the Legislature (and we have found no contradictory testimony on this point) that in less than four years five epidemics due to milk had resulted in 70 cases of diphtheria, 700 cases of scarlet fever, and 557 cases of typhoid fever in Boston and its immediate vicinity.

From a combined source of data (consisting of (*a*) replies to a questionnaire sent to the local boards of health and (*b*) an analysis of the investigations of outbreaks of infectious diseases made by the State Inspectors of Health) in Greater Boston, there can reasonably be attributed to infected milk during the six-year period, 1909–14 (inclusive), 6 cases of diphtheria, 845 cases of scarlet fever, 1,000+ cases of septic sore throat and 365 cases of typhoid. Thus, in five epidemics occurring between January, 1907, and July, 1910, 1,397 cases of milk-borne infectious diseases occurred in Greater Boston, while in the same locality in the six-year period, 1909–14 (inclusive), from all available sources, 2,210+ cases of typhoid, scarlet fever and septic sore throat have been traced to milk.

When it is recalled that by far the greater portion of Greater Boston's milk supply is from pasteurized sources, and that all these cases proved to have been due to comparatively small raw milk supplies, the seriousness of the milk problem, as it

pertains to the occurrence of the diseases in question, cannot be denied or ignored.

At one time we contemplated making a similar analysis for the same period of the milk-borne epidemics in comparison with the total number of epidemics of these same diseases reported by those States having the most complete communicable disease reporting systems. Correspondence with the epidemiologists of various States indicated that such data were not in readily available form in any of them, and distance and lack of time have prevented us going any further into this most interesting and suggestive line of investigation.

A careful, although by no means exhaustive, search of English references throws no light upon the subject, although we rather suspect that such data may be available. We have made no examinations in reference to this point into Scandinavian contributions to the milk question, and consider that any search into the data available from other European countries, aside from Great Britain and Scandinavia, would be time wasted because of (*a*) the widespread use of goat's milk in many parts of the continent milked in containers furnished by the consumers at the consumer's door, and (*b*) an almost universal European practice of boiling the milk as a sanitary precaution.

(2) Evidence as to the Total Relative Importance of Milk Infection in the Transmission of Certain Communicable Diseases of Man based on their Occurrence in Endemic or Sporadic Form as well as in Epidemics.

Although diligently sought, practically no authoritative data, in our opinion, can be obtained at present upon this important point. Moreover, such statements, generalizations, inferences and hypotheses as are found in milk literature bearing on this subject are not only resting on far from conclusive epidemiological foundations, but are in many instances rather contrary to such fragmentary epidemiological evidence as we have been able to uncover.

It is easy to see that the temptation to make out the case against milk as strong and startling as possible, buttressed by

the spectacular corroborative evidence of the milk-borne *epidemic*, has had a tendency to produce these sweeping statements and charges in regard to milk infection.

It is an interesting reflection upon the inadequate development of practical disease-preventive measures in this country to note that the routine machinery of no State and of but few city health departments is at the present time developed to such a comparatively modest degree of efficiency as will enable them to make routine investigations into the *reported* cases of these diseases, known to be at times milk borne, sufficient to bring out whether or not milk should be considered as a certain or probable source of infection in any given case or group of cases.

In the course of its investigations this Board has made a careful and, we believe, a fairly representative study of the best available modern milk literature, with special reference to its bearing upon infectious diseases, infant mortality and the gastroenteritides of children.

We have been forcibly struck with the casual, elusive and vague character of statements which continually recur relative to the proportional significance of infected milk to these disease conditions.

The literature of milk, when it comes down to this concrete problem, either admits the total inadequacy of present data on the relative significance of milk infection in disease transmission, or is discreetly silent, or more often takes refuge in indefinite and elusive generalizations.

In attempting to arrive at some conclusions in this matter the following sources of evidence have been carefully considered: —

(*a*) Replies to a questionnaire sent to Massachusetts cities and towns.

(*b*) Written and verbal statements of the epidemiological authorities of various States.

(*c*) The reports of the special typhoid board of the United States Public Health and Marine Hospital service in the District of Columbia (1906–10).

(*d*) The evidence of the records of the Boston City Health

Department supplemented by the evidence of the records of certain other Massachusetts cities.

(*e*) Epidemiological résumés of the New York City Health Department, with special reference to milk, including the residual typhoid theory, by Dr. M. L. Ogan of the New York City Health Department.

(*f*) "Milk and its Relation to the Public Health" (United States Public Health and Marine Hospital Service, Hygienic Laboratory Bulletins Nos. 41 and 56).

(*g*) Miscellaneous works on milk, or incidental references to milk in connection with communicable disease by American and foreign authorities other than above (practically all English).

(*a*) *Replies to a Questionnaire sent to Massachusetts Cities and Towns.*

Owing to the fact that Massachusetts local boards of health are required by law to report to the State health authorities only the names, addresses, diagnoses and dates upon which cases of infectious diseases are reported to them, and that the routine notifications to the State Health Department are limited strictly to this information, the records of the Massachusetts State Health Department throw no light whatever upon the question under discussion. Thinking that a statement covering the entire State, based on the records of the local boards of health, would throw some light on the problem, your Board prepared and sent out in July of this year a circular questionnaire to all of the local boards of health in the Commonwealth. Owing to very incomplete replies a second letter, explaining a little more in detail the purposes of the inquiry, was sent to those cities and towns that had failed to reply in July. (See Appendix B.)

The form of the questionnaire was extremely simple. A statement was requested of the total number of cases of typhoid fever, diphtheria, scarlet fever and septic sore throat reported to the local board during the five-year period, 1909–13; of the number recorded as due to milk infection following investigation by the local board; the number suspected of being milk borne without conclusive evidence being obtained; the total number of deaths from the same diseases in the correspond-

ing period, and the number of such deaths attributed to milk infection.

When we consider the widespread interest relative to the connection between the milk supply and the public health that has prevailed in this Commonwealth for some years past, and the amount of public agitation that has arisen in relation thereto, it must be confessed that the total returns from this questionnaire were somewhat disappointing. It was sent out merely as a means of obtaining the facts relative to milk and communicable disease prevalence, and of supplying information that the State health authorities had no other means of procuring, and we had mistakenly anticipated a very complete response. However, whether from procrastination, thoughtlessness or a deliberate intent not to co-operate in this matter, one city and 156 towns, representing in all a population of 556,554, or about 16 per cent. of the total population (Census 1910), failed to make any reply or acknowledge receipt of the two requests up to date.

Of the entire group of cities and towns replying, 34 cities and 162 towns, respectively, representing a population of 2,809,862 (Census 1910), or 84 per cent. of the State, the greater majority replied in full. A number of the smaller towns, however, simply replied "no records." We have been somewhat in doubt whether to interpret this reply as meaning that these boards of health actually kept no records of communicable diseases, or whether it meant that in the period covered no cases of the diseases concerning which information was sought had been reported.

Forty towns, having an aggregate population of 50,134, state that no cases of these diseases due to any causes have been reported in this period to their local boards of health. Inasmuch as the "no record" towns and "no cases" towns are all comparatively small, it may be reasonably inferred that at least no outbreak of these diseases could have occurred in any of them during the period under inquiry, for such an occurrence would have been practically certain to have become a matter of record in the local board of health office. It is also true that in practically all of these towns the machinery of milk production and distribution is extremely simple.

The remaining 102 towns and the 34 cities — answering the questionnaire represent a total population of 2,703,759. They report as follows: —

Diseases.	Total Number of Cases, 1909-13.	Cases due to Milk.	Cases Milk suspected. [1]
Typhoid fever,	11,282	553	135
Diphtheria,	31,866	11	49
Scarlet fever,	31,012	495	57
Septic sore throat,	2,436	1,914	–
Totals,	76,596	2,973	241

Diseases.	Total Number of Deaths, 1909-13.	Deaths due to Milk.	Deaths Milk suspected. [1]
Typhoid fever,	1,425	37	8
Diphtheria,	2,580	1	1
Scarlet fever,	991	8	–
Septic sore throat,	49	48	–
Totals,	5,045	94	9

Analysis of these totals demonstrates that in only 0.03 per cent. of cases has the transmission of diphtheria been definitely assigned to infected milk, and in only .19 per cent. was milk either proven or suspected; 1.6 per cent. of the reported cases of scarlet fever have been definitely attributed to milk infection, and 1.8 per cent. proven or suspected; in 79 per cent. of the cases of septic sore throat (not reportable until 1914) milk was assigned as the cause; in 5 per cent. of the cases of typhoid milk was definitely assigned as the cause, and in 6 per cent. milk was either proven or suspected to be the agent of infection in this disease. Taking all of these diseases in a group, 3.9 per cent. were definitely attributed to milk, and in 4 per cent. of all the cases milk was proven or suspected. Considering mortality, 3 per cent. of typhoid deaths are possibly attributable to milk, 0.08 per cent. of diphtheria deaths, 0.8 per cent. scarlet fever deaths, 98 per cent. septic sore throat deaths; an average for the whole group of 2 per cent. of the deaths may be attributed to infected milk.

[1] "Suspected" here means that milk was considered to be the probable source of infection, but was not conclusively proven.

(*b*) *Written and Verbal Statements of the Epidemiological Authorities of Various States.*

Specific information upon the point under discussion, *i.e.*, the endemic prevalence of milk infections, was sought from the epidemiological authorities of the States of New York, New Jersey, Pennsylvania, Maryland, Minnesota and Kansas. (See Appendix D.) These States were selected because they, and, as far as we are aware, they only among the several States, have communicable disease reporting systems analogous to the Massachusetts system. In fact, the morbidity reporting systems of these States, which place in the hands of the State health authorities the individual case reports of communicable diseases, are supposed to furnish more direct epidemiological data than does the Massachusetts system. But, as was the experience in relation to the epidemic prevalence of milk-borne infections, none of these States was in a position to furnish even roughly approximate quantitative returns. A résumé of the replies follows: —

Kansas (correspondence only). — Reported only two epidemics traceable to milk on record, but stated that others have occurred. Could furnish nothing as to endemic frequency of milk infection.

New Jersey (correspondence only). — Furnished nothing on endemic frequency of milk infection. Referred to several interesting milk-borne epidemics.

Pennsylvania. — No reply.

Maryland (correspondence and verbal) (See Appendix). — Furnished no data relative to the endemic factor of milk in their diseases. Stated that they have had eight outbreaks of typhoid, aggregating 390 cases, which were milk borne, from 1884 to date, and one of septic sore throat in 1912, involving somewhere between 1,000 and 3,000 cases.

New York (correspondence and verbal). — Gave some interesting epidemics, some of considerable extent, of all the diseases under consideration. Stated that as yet no analysis of endemic prevalence had been made by examining either the records of local boards of health, or by analysis of the original reports received from physicians on file in the Communicable Disease Division of the State Health Department, but expressed an opinion that such a study might be profitably made.

Minnesota (correspondence and verbal) (See Appendix). — The exact language used in replying to our letter of inquiry by the director of the Division of Preventable Diseases of the Minnesota Board of Health is as follows: —

In endeavoring to comply with your request regarding instances in which milk has been implicated in the transmission of scarlet fever, diphtheria and typhoid fever I am somewhat disappointed. Dr. Greene was kind enough to go through the records of the division very carefully from Aug. 1, 1909, to date. He made a card index of reports where it *seemed* that milk *might* have been a factor in the spread of infection. I have personally gone through *all* these reports. While many of them indicate that milk was a factor *to some extent* in the spread of disease, only in a few was milk the chief route of infection, or definitely proven to be even an *active* factor. I may say that in several epidemics which I personally investigated there was strong *circumstantial* evidence indicating that milk was the main route of infection. However, careful investigation proved that appearances were deceiving, for it was readily shown that the milk could not have been infected, and the cases suspected to be milk infections were traced to direct contact with known cases at a time which would fully account for the infection.

In addition, reference was made to a considerable number of true milk-borne epidemics, including one of typhoid which was due to butter, another, also typhoid, due to both milk and cheese, and five other milk-borne typhoid outbreaks, two diphtheria outbreaks, one each from milk and butter, and one definite and three doubtful milk outbreaks of scarlet fever. In personal interviews the director of the Minnesota Division of Preventable Diseases expressed a strong skepticism as to the comparative frequency of milk infection in both sporadic and epidemic cases of these diseases.

(*c*) *The Reports of the Special Typhoid Board of the United States Public Health and Marine Hospital Service on the Origin and Prevalence of Typhoid Fever in the District of Columbia* (*1906–09*).

Although these reports deal exclusively with typhoid, yet they have a very great significance because of the exceptional thoroughness with which the epidemiological studies were made, their continuance through a series of years (four), sufficient to offset to some degree the exceptional factors of any single year, and the fact that the results of this study have in a general way passed current for several years among American sanitarians as an approximately correct index to the relative importance of milk infection to the spread of typhoid. In trying to arrive at a fair and just appreciation of the significance of their results, three facts need to be borne in mind.

1. That the total number of milk-borne cases of typhoid reported upon in this series are explicitly stated to be *all* cases occurring under *epidemic* conditions; in fact, to have been due

to six well-defined epidemics. It is striking that such a small number of localized milk-borne typhoid outbreaks should have produced so high a percentage of the local typhoid.

2. That while the percentage of cases, attributed to milk transmission, for the first three years are all approximately 10 per cent., the fourth year the percentage drops abruptly to 2.2 per cent.

3. That the great proportion of cases unaccounted for may or may not have contained a considerable number of cases in which the infection was milk borne. If so, and *if the milk epidemics occurring in the three earlier years represent a fair average of the relative frequency with which milk-borne infections occur*, the relative importance of milk-borne infection in typhoid is high. If the contrary be true, its relative significance compared to contact, or water, is perhaps quite small.

Although these studies relate to District of Columbia conditions exclusively, the conclusion is unescapable, although they nowhere definitely express such an opinion, that these investigators are strong adherents of the view that milk is a very great factor, relatively speaking, in the transmission of American urban typhoid. We particularly value their evidence because it rests on a basis of careful epidemiological work, and is, together with Ogan's New York City work, the *only* evidence we have found that is at all reliable pointing towards a substantiation of the relatively high milk factor that has been so commonly, not to say recklessly, assumed by so many authorities.

The unqualified fashion in which these investigators commit themselves to this "high milk-borne percentage" theory of typhoid transmission can be clearly seen by the following statements: —

> Since so many cases occurred in the course of definite and readily recognizable milk outbreaks, it is almost certain that *a number of scattering cases, probably aggregating more than the number definitely attributable to milk-borne infection*, resulted from milk-borne infection.

And again: —

> In each of the four years the cases attributed to milk-borne infection comprised only the cases which occurred in the course of pronounced

outbreaks among the customers of certain dairymen. In view of the way in which the bulk of the milk consumed in Washington is handled, it may be *logically surmised* that the proportions of cases caused by milk-borne infection were considerably larger than the figures in the summary indicate.

Whether the Washington experience can be assumed as fairly typical for American cities is another question. It is interesting to note that although these investigators, reporting on a population of approximately one-third of a million, found *six* distinct milk-borne outbreaks in a space of four consecutive years, the Maryland State Board of Health, reporting for a population approximately a million greater, only recorded a total of eight milk-borne typhoid outbreaks in thirty-one years. Since Maryland all but surrounds the city of Washington, climatic, social and racial factors are fairly comparable, and even though it be conceded that a great many outbreaks have been overlooked by the Maryland authorities, as is undoubtedly the case, yet it at once raises the question as to whether the three years 1906, 1907, 1908 may not have represented unusually high years for milk-borne typhoid outbreaks in Washington.

The investigators apparently unhesitatingly assume that the low percentage of infection definitely attributable to milk during 1909 (2.2 per cent. in contrast to the average of 10 per cent. so accounted for during the three years previous) can be explained entirely by improvement in the milk supply, or, to quote their own words: "The number of cases definitely attributable to milk-borne infection was considerably smaller in 1909 than in any of the three previous years, and it appears quite probable that the decrease in the typhoid rate in Washington since 1906 has been due in part to the improvement in the city's milk supply from year to year."

No data are given to indicate upon what ground the statement relative to the improvement in the city's milk supply is based, but inasmuch as the percentages of the milk-borne cases for 1906, 1907, 1908 are remarkably even, and the 1908 percentage exceeds, although only by a fraction, that of 1907, it is a little difficult to deduce from this just where the improvement "from year to year" was manifesting itself in such a fashion as to explain the 75 per cent. "frequency drop" of

1909, and we respectfully suggest that these consecutive "high percentages" years may have been of themselves an anomaly.

Every analysis of the six outbreaks listed by these investigators discloses several interesting facts. In 1908 one distinct outbreak is recorded involving 52 cases. This outbreak was followed up, the carrier detected, typhoid bacilli isolated from her feces, sale of milk from her premises stopped, and the outbreak abruptly terminated. This outbreak certainly fulfilled the most exacting epidemiological requirements of proof.

In 1909 the single outbreak attributed to milk failed of confirmation by application of laboratory methods for detection of carriers to all who had to do with the milk, although the circumstantial epidemiological evidence was very strong.

In the other four epidemics, so far as the evidence appears, the only basis for classifying these groups of typhoid fever as distinct milk outbreaks was the suspicious frequency of the occurrence of typhoid cases upon the routes of certain dealers.

We admit that this reasoning is plausible, but in the absence of any statement as to past epidemiological history of milk producers on the farms and the dairy employees distributing these milks, and in the absence of any laboratory confirmative work, we consider that the conclusions do not rest upon sufficiently sound epidemiological proofs to consider them as fairly attributable.

Therefore, in all, we find but one of these six outbreaks completely proved (the carrier case in 1908). The other five outbreaks, which the authors consider as positive outbreaks, all present gaps in evidence of more or less serious nature.

Another extremely interesting observation by the authors is the following: In the last year reported they state that 4 dairymen, all doing a relatively large business, were that year pasteurizing their milk, and they make the observation that 1 of them had practiced pasteurization for the whole period (four years); 2 only began in the middle of 1908; and 1, July 1, 1909. They present a table showing that the number of cases on these three dealers' routes per 100,000 gallons of milk distributed had shown a sharp decline since inaugurating pasteurization. This argument is rather weak, in our opinion, for

the periods both before and after pasteurization are too short to justify any deductions as to the cause and effect connection between pasteurization and typhoid incidence, although in the case of the dealer who pasteurized throughout, and consistently had low incidence per 100,000 gallons, the argument may be given some weight.

The rates of typhoid incidence per 100,000 gallons of milk distributed, given year by year for the three dealers, are as follows (the heavy-faced figures indicate time when pasteurization began): —

	No. 3.	No. 4.	No. 8.
1906,	16.6	52.5	35.6
1907,	**7.1**	**21.6**	17.1
1908,	5.8	10.1	**18.8**
1909,	1.4	7.0	6.9

It is possible to pick three other dealers, also selling large amounts, who *never* pasteurized, and show the same striking tabular drops; for example: —

	No. 2.	No. 5.	No. 7.
1906,	21.5	23.7	35.0
1907,	23.4	15.6	13.6
1908,	10.2	13.3	9.1
1909,	4.2	8.0	7.8

The investigators seem to believe that their pasteurization showing is strong corroborative proof of milk infection being a very important factor in the transmission of typhoid. If all four of the dealers who pasteurized their product in 1909 are considered in a group, their total output is 799,000 gallons of pasteurized milk. They also had a total of 39 cases of typhoid on their routes. Presumably the majority of these, at least, would be considered as due to other causes than milk by the investigators. But if the 16 other dealers, whose total gallon outputs are similarly given, are considered as one group, an

interesting comparison ensues. In this group there is a total output of 1,514,000 gallons of *unpasteurized* milk, and there occurred 98 cases of typhoid on *their* routes. However, among them is the one very small dealer (putting out only 7,000 gallons in the period) on whose route occurred the outbreak of 13 cases, which have been considered by the investigators as unquestionably milk borne. Deducting these, it leaves a total of 85 cases to 1,507,000 gallons of milk distributed. *But the ratios of 39 to 799,000* and *85 to 1,507,000 are substantially the same.*

We would not have our exceptions to their pasteurization argument interpreted as meaning that we are skeptical as to the value of efficient pasteurization as an agency in controlling disease transmission through milk. We merely wish to point out that, so far as the Washington typhoid series are concerned, pasteurization was not applied long enough or generally enough to fairly attribute typhoid reduction to its influence. This mathematical comparison leaves the arguments of the investigators, in which they give the impression that milk infection is a major although undeterminable factor in the spread of the Washington typhoid of unattributed causation, rather up in the air. For it is quite evident that they are citing the progressive decline in the number of cases per 100,000 gallons of milk distributed on the routes of the dairymen practicing pasteurization, after the institution of the practice, as inferential evidence that milk infection played a large part in the transmission of typhoid on their routes *before they began pasteurization.*

(*d*) *The Evidence of the Records of the Boston City Health Department supplemented by the Evidence of the Records of Certain Other Massachusetts Cities.*

It is a source of regret to your Board that we did not earlier realize the great possibilities of a more extensive quantitative analysis of the records of communicable diseases of the large cities of the country having well-equipped health departments, in reference to the question of the frequency of milk transmission of disease. To make this study of most value, the precise methods followed as to epidemiological and laboratory proce-

dure by each city would need to be clearly known, the relative efficiency of reporting by physicians, the proportion of certified and pasteurized milk used and periods when introduced, and above all, the basis upon which each department made its routine classification as the channels of transmission. Studies among cities of under 100,000 would not be of the same relative weight, because the total series could not be sufficiently large to safely draw true relative deductions.

But we believe that carefully analyzed returns from city health departments of such standards as those of Boston, Providence, Baltimore, New York, Chicago, Seattle, and many others where careful epidemiological and laboratory work is carried out on every communicable disease case as a *routine*, would throw a great deal of light upon this very dark subject.

Because of the fact that the records of the Boston City Health Department have been immediately accessible to your Board, we have had opportunity to appraise carefully the methods of procedure upon which these classifications rest, and the more we have gone into this subject, through conference with the authorities of the Boston Health Department, the more we have been impressed with the thoroughness and reliability of their routine investigations of communicable diseases as regards the demonstrable or probable sources of infection. On these grounds, on account of the large aggregate number of cases and the very evident high degree of co-operation on the part of the practicing physicians of the city in reporting and suggesting epidemiological clues to the health officials, we place a very high degree of confidence in their returns.

According to the data furnished us by the Division of Communicable Diseases of the Boston City Health Department, out of a grand total of *23,336* cases of typhoid, diphtheria, scarlet fever and septic sore throat, recorded by the Department in the *five*-year period, 1909–13, inclusive, only *1,132* cases have been attributed to milk-borne infection, *following careful epidemiological investigations of each individual case.* In Boston the physicians practically never report a case of streptococcic throat infection as "septic sore throat," except in the presence of a milk-borne epidemic. Therefore the percentage of septic sore throat among the milk-borne diseases is practically 100 per cent. When this disease is excluded the relative proportions

are: total diphtheria, scarlet fever and typhoid cases, 22,536; total cases of same diseases attributed to milk, 332. This gives milk a total percentage importance among the total channels of infection for these diseases for the city of Boston, for five years, of approximately 1.5 per cent. If septic sore throat is included, the total percentage of cases due to infected milk for the entire group of the four diseases rises to approximately 5 per cent.

The most interesting point of all in connection with the Boston experience is that all of these cases occurred in *non-pasteurized* milk supplies. However, the number of dealers involved in these non-pasteurized supplies are about 250, or 83 per cent. of the total number of dealers.

The percentage of pasteurized supply to the total supply has considerably increased during the five years. The Boston Health Department estimates the percentage of pasteurized milk (including cream) in these years to be as follows: —

	Per Cent.	Gallons sold Yearly.
1909,	30.68	22,297,722
1910,	49.90	23,150,125
1911,	73.62	24,170,026
1912,	70.59	24,745,423
1913,	80.63	27,635,785
Average,	62.63	24,499,785

The Boston authorities feel, and with good epidemiological basis, that the extension of pasteurization has been a most efficacious safeguard against the possible more extensive transmission of outbreaks of the diseases under consideration through milk.

But apparently, just as in the case of the Washington, D. C., typhoid series, it is scarcely justifiable to conclude that there would of necessity have been a much greater occurrence of milk-borne diseases in the city if the milk had not been so generally pasteurized than actually was the case.

Seven other of the larger cities of Massachusetts — Fall River, Pittsfield, Brockton, Lowell, New Bedford, Springfield and Worcester — had in 1910 an aggregate population of

646,152. This population is fairly comparable to the population of Boston in 1910, — 670,586. But only two of these — Springfield and Worcester — have at present a considerable percentage of milk pasteurized. Springfield has 38 per cent. pasteurized; Worcester, 30 per cent.; Fall River, 14 per cent.; Brockton, 8 per cent.; Lowell, 7 per cent.; Pittsfield, 0 per cent. New Bedford states that practically none of the milk supply of that city is pasteurized. This gives an average pasteurization of 19.5 per cent. for this group.

The total number of diphtheria cases returned during the same five-year period as definitely or possibly due to milk infection for this group of cities is 0; of septic sore throat, 0; of scarlet fever, 0; and of typhoid, 280. The total number of cases of diphtheria, scarlet fever, septic sore throat and typhoid returned by this group for the same period is 16,948. This gives a percentage of milk-borne cases of these diseases (in this series, all typhoid), for the five-year period for these cities, of 1.5 per cent., the same as the Boston percentage for five years (omitting the septic sore throat cases) of 1.5 per cent.

Such results as these were not in the least anticipated when we began this quantitative study. We confess to surprise, even astonishment at reaching quantitative results so far apart from those generally current as to the relative frequency of milk infection. What can such results mean? Do they mean that milk outbreaks have been overlooked right and left by these city departments? Very possible, but not probable. All of these departments are considered efficient. If pasteurization is as important as we have always been led to believe in stopping the incidence of milk-borne infection, and if milk-borne infections are anywhere nearly as frequent an occurrence in non-supervised milk supplies as has been practically universally assumed for years, then the relative percentage of milk-borne infections in these cities from unmistakable outbreaks ought to be materially higher than the percentage of Boston's milk-borne outbreaks, due in every instance to that city's relatively small raw milk supply.

These points are suggestive: —

First. — It is rather surprising to find that these 7 cities, whose aggregate population is only slightly less than that of Boston, report only about three-fourths as many cases of the

diseases under consideration *from all causes.* Whether this means less efficient reporting by the physicians of these cities, or an actual lower frequency of occurrence of these diseases than in Boston, we are unable to determine accurately, but we believe the latter rather than the former factor is principally concerned.

Second. — If milk were in reality a considerable factor in the causation of sporadic cases of these diseases there should be a reflection of this effect in an increase of the general frequency rate of these diseases, — the exact antithesis of what is found.

Third. — Another possible explanation of this discrepancy in the comparative frequency of incidence of diphtheria, scarlet fever and typhoid in this group of cities, when contrasted with Boston, may be their smaller concentration of mass of population, with its concomitant lessened opportunities for contact infection.

Fourth. — For the most part the milk supply of these cities is subject to the "short haul." Just what relation this may possibly have in reference to the transmission of communicable diseases it is difficult to state, especially as all the dairies implicated in the Boston series are also "short haul" dairies.

Fifth. — Nearly two-thirds of all the cases returned as due to milk infection in this group are attributable to *one* carefully demonstrated typhoid milk infection from a urinary carrier.

This again rather suggests that milk-borne typhoid, scarlet fever and diphtheria are possibly essentially epidemic rather than sporadic in nature; that possibly they occur only when a certain complete chain of circumstances in reference to the carrier or infected person and milk exists, permitting a rather massive infection of the milk; and that these circumstances do not occur nearly as often, in the aggregate, as we have been led to believe from the spectacular and striking character of the results when such infections do take place.

(*e*) *The Residual Typhoid Theory of Ogan.*

Probably no other city in the country makes as careful a study of its communicable diseases from the standpoint of epidemiology as New York. Dr. M. L. Ogan, chief of the Division of Epidemiology of that Department, has made some interest-

ing and suggestive studies as to the possible milk factor in the transmission of typhoid in that city.

His results are particularly interesting, as he comes to the conclusion that probably 30 per cent. of the endemic typhoid in 1912 — the last year before pasteurization became practically universal in New York — was due to infection through milk. To abstract his own words, this conclusion was arrived at by noting that one large company supplying 325,000 people, or 12 per cent. of the population of Manhattan borough, had among its patrons, using its milk exclusively, 111 cases of typhoid in 1912. At this ratio the whole population, had it used this milk exclusively, should have had only 839 cases, assuming that pasteurized milk could not transmit typhoid; but from the whole population 1,184 cases were reported for the year, hence there is left a residue of 345 cases, or 30 per cent. of the whole, which *according to this method of reasoning* (italics ours) are due to milk. The author then adds another 9 per cent. which was attributed — on good epidemiological grounds, we assume, although the method or basis of classification is not given — to milk-borne epidemics, and concludes that it is not unreasonable to attribute a total of 39 per cent. of the borough's typhoid of that year to milk (30 per cent. endemic plus 9 per cent. epidemic). He then admits that other factors might have had an effect in the reduction of typhoid between 1911 and 1914 which is in all 53 per cent., mentioning better oyster supply, better water supply, more stringent food handling sanitary regulations, and advance in sanitary intelligence on the part of the general public. He also states that this method of computing the residual milk factor in typhoid is open to some criticism, and in this last we are forced to agree with him.

In brief, while we cannot but admire the ingenuity of his reasoning, and have the deepest respect for the painstaking epidemiological and laboratory work that lies back of it, we cannot see that his conclusions are justifiable; too many other possible factors still remain unexcluded.

(*f*) *"Milk and its Relationship to the Public Health" (Bulletins No. 41 and 56 of the Hygienic Laboratory, United States Public Health and Marine Hospital Service, 1908).*

This report has a rather unique claim to authority among the contributions to the literature of milk. It represents the final joint conclusions of the medical and agricultural experts of the Federal government upon this subject, based on painstaking studies and researches of their own, as well as careful and exhaustive reviews of the results of other workers throughout the world. It may be safely rated as one of the most, if not the most, painstaking investigations into the subject ever known. It fills a bulky volume of over 800 pages.

Nevertheless, in searching carefully through it for information as to the quantitative relation between infected milk and the transmission of infectious diseases, the nearest to a definite statement that we can find is the following rather cryptic sentence by Eager. He says: "The effect of milk epidemics on morbidity and mortality returns may be surmised by the frequency with which such epidemics occur."

Such statements as these are simply concealing our ignorance of this subject, our utter lack of reliable knowledge, by impressive sounding phrases that get us nowhere. Moreover, if Massachusetts' experience is in the slightest degree reliable, the prevalence of these diseases in epidemics due to all causes bears but a minor percentage relation to their total occurrence, and, *among epidemics*, only a minor percentage can be justly attributed to milk.

(*g*) *General Literature of Milk (American and Foreign).*

We have studied carefully, though by no means exhaustively, American and English authorities for definite statements based on sound epidemiological studies relative to the comparative importance of milk transmission in the spread of those communicable diseases of man which are transmitted at times through the medium of infected milk. The general consensus of expert opinion relative to tuberculosis and milk has already been covered.

In studying the general literature of milk and the literature

of epidemiology in respect to its incidental discussions of milk transmission of diseases, especially in reference to the great trio of epidemic diseases that are universally conceded to be at times milk borne, — *i.e.*, diphtheria, scarlet fever and typhoid, — statements continually recur of which the best that can be said is that they shade from the frankly negative, or the evidently purposely vague, to the entirely hypothetical in reference to this important problem.

As we have repeatedly pointed out, the striking spectacular evidence is always that of the milk-borne, or alleged milk-borne, epidemic, and this type has been given the entire attention of the authorities that we have consulted, with one notable and authoritative exception, — Chapin. When some incidental reference is made to the problem of the relative significance of milk infection, about the only surmises hazarded are in reference to typhoid. Three in particular have struck our attention forcibly from the widespread manner in which they are quoted as a basis for judgment. One is the now classical report by Harrington, in reference to 14 out of a total of 18 typhoid outbreaks in Massachusetts being due to milk. Another is the assumed 10 per cent. factor of milk infection in typhoid transmission of the Typhoid Board of the United States Public Health and Marine Hospital Service for the District of Columbia. We have already discussed the fairness of these two conclusions in detail. A third reference is worthy of special notice, as it has been quoted quite as widely as the other two, and because it may be fairly cited as a typical example of the sweeping generalizations as to the dangers of milk that can be found in many quarters. We refer to Whipple's well-known work on "Typhoid Fever." Another reason why we feel it is particularly worthy of citation is because the eminent author frankly admits that the assertion rests on no solid epidemiological basis, and because in justice to him it should be noted that in another chapter of the same work, devoted exclusively to the effect of milk supplies upon typhoid rates of cities, he particularly gives this wise caution in reference to the matter: ". . . the data for a fair discussion of this subject have not yet been collected." We have never found this statement quoted.

But very casually on another page in the chapter devoted to the distribution of typhoid he makes this incautious statement which we have found quoted, apparently with approbation, in numerous places: "In a general sort of way it may be said that in the cities of the United States at the present time about 40 per cent. of the typhoid fever is due to water, 25 per cent. to milk, 30 per cent. to ordinary contagion (including fly transmission), and about 5 per cent. to all other causes."

The one good authority who challenges the fairness and accuracy of these assertions as to the high percentage importance of milk infection in the transmission of diphtheria, scarlet fever and typhoid is Chapin of Providence. In his work on "The Sources and Modes of Infection" he says: —

It will be noted that though scores of outbreaks of typhoid fever may occur each year, they do not include more than a small fraction of the total typhoid fever. It may be claimed that only a small proportion of the milk-borne outbreaks are recognized as such, but I cannot think that this is so in the English cities and the *better class of American cities*. . . . We can hardly believe that milk outbreaks could have, except rarely, escaped detection in the English cities, or in such cities as Boston, Worcester, Springfield, Rochester, Baltimore, Philadelphia and New York.

The importance and value of the reports on typhoid fever in Washington have, as it appears, given a rather exaggerated importance to the danger from milk. That there was a certain amount of typhoid fever in Washington, due to milk, during the three years in question, is no reason for assuming a similar percentage of milk-borne typhoid fever for the other cities of the country. Trask was able to find during the years 1903–07 about 1,900 cases in the United States traced to milk. During this period there were in the registration area 57,023 deaths, and the total number in the whole country must have been at least double, or 114,000. The fatality is probably not over 10 per cent., so that there must have been at least 1,000,000 cases. Nineteen hundred is 0.19 per cent., which is very different from the 10 per cent. now commonly assumed as due to milk. I do not of course believe that all the milk outbreaks were reported, but the number would have to be increased fiftyfold to equal 10 per cent., and it can scarcely be believed that 98 per cent. of all milk outbreaks fail of recognition.

In reference to diphtheria and scarlet fever transmission by milk, he further states: —

Scarlet fever and diphtheria are certainly much more rarely transmitted by means of milk than is typhoid fever. Although the percentage

of typhoid fever, scarlet fever and diphtheria due to milk is small, the danger is a real one and the aggregate of cases not inconsiderable and their occurrence should, if possible, be guarded against.

In all this epidemiological quagmire it is refreshing to be able to quote at least one authoritative, incisive, sane voice emphatically demanding that in making our final judgments in this matter we take our stand upon the definitely proven facts, and do not pass judgment in advance relative to the great mass of cases of infectious diseases whose etiology we must as yet, in all fairness, class as unproven.

Summary of Evidence available as to the Relative Importance of Milk in the Transmission of Infectious Diseases.

To sum up, the best available information as to the proportionate part played by milk supplies in general in the transmission of the great trio of milk-borne epidemic diseases — diphtheria, scarlet fever and typhoid — amounts in substance to about as follows: —

1. That there have been throughout the civilized world up to the present time a large number of well-authenticated epidemics of all of these diseases, definitely due to milk infection. No one can state at present just how many such epidemics there are on record, but they are ample in number to prove the danger of disease transmission through raw milk. From the accumulated evidence it is possible to state quite definitely that there is a vast discrepancy as to the relative frequency of milk infection in these diseases, diphtheria being clearly the least often so transmitted, scarlet fever relatively more often, and typhoid unquestionably more frequently than both the other two combined. The fourth, as yet little understood disease, that is known to be transmitted by milk — septic sore throat — is, in the best understanding of the term nowadays, considered to be practically always a milk infection.

2. That analysis of both the epidemic and endemic records of these diseases in the State of Massachusetts for several years past would tend to indicate that the total relative importance of infected milk in the transmission of these diseases is not nearly as great as has been commonly assumed.

3. From a study of all the available literature on the subject it would appear that three sources have been largely responsible for the widespread impression among American sanitarians that milk infection has been definitely proven to be a high factor in the transmission of these diseases. They curiously all relate to typhoid alone. They are: (*a*) Harrington's report of 14 out of 18 typhoid epidemics being found due to milk; (*b*) the reports of the special typhoid board on the origin and prevalence of typhoid in the District of Columbia; and (*c*) the milk percentage statement by Whipple in his work on typhoid fever. We are unable to substantiate the conclusions of any of these reports for reasons detailed above.

4. Replies to inquiries among prominent American epidemiologists are unanimous in testifying that the evidence as to just what part milk plays in the transmission of these diseases is not by any means conclusive. Almost without exception they admit that the tendency of their own experiences is to explain more and more cases of these diseases on other grounds than milk.

5. We can find nothing authoritative in any other general public health or medical literature that throws any conclusive light on this point.

6. The high residual milk-borne typhoid argument of Ogan of the New York City Health Department is a very suggestive theory, but in our opinion not in any sense conclusive.

7. Our own results do not in any sense prove conclusively that milk is *not* as important a factor as has been assumed. They simply go a long way towards demonstrating that the reasons hitherto given for the assumption that milk is a large factor in the transmission of infectious diseases are in many respects inadequate and unsatisfactory.

In brief, it is our belief that all statements, conclusions and broad general impressions as to the *relative* dangers of milk found in the literature rest on a most shaky and unsubstantial basis.

We believe that this tendency is wrong. The accumulated evidence of scores upon scores of definitely demonstrated milk-borne epidemics is enough to show that raw market milk is always a risky food. Why not let it go at that? Why lend color to the charge that practical milk producers so often have

flung in our faces during the progress of this investigation, viz., that the tendency of sanitarians to-day is to create the impression that milk is inherently little if any short of a poison. This impression has been undoubtedly created in many people's minds by sweeping, startling, unqualified accusations against cow's milk that may or may not be justified, and concerning which we have at present no sound basis whatever in the shape of good epidemiological proof.

5. The Possible Means of preventing Communicable Disease Transmission through Milk, and their Relative Practicability.

Enough has been shown to demonstrate that, while milk is probably not as great a factor in communicable disease transmission as has often been asserted, it is none the less a very real and serious element in the problem of communicable disease prevention. The next logical step is to eradicate or minimize this danger. One effective way is that of Japan and certain other Oriental races, — not to use the milk of the cow for human food. The great benefits that we derive from the use of cow's milk are so evident that such a procedure is unthinkable for an American community.

There remains the problem of how cow's milk may be made safe as far as communicable diseases are concerned. All the numerous expedients and measures advocated or adopted throughout the civilized world with this end in view can be reduced to two general classifications.

1. Efforts to produce a milk that from the cow to the ultimate consumer presents no opportunity for infection.

2. Efforts at disinfection of the milk in some manner by which the opportunities for subsequent infection would be reduced to a minimum.

In the pursuit of these ends, as in many other aspects of the milk problem, there has been such a strong bias or prejudice on the part of many advocates of these two opposing views that it has rather tended to obscure the fact that there might be a very distinct, practical and sane middle course available between the two extremes.

The advocates of the cause of raw milk have blindly shut their eyes to certain ugly facts relative to milk and disease

transmission, and have enormously extended the prejudice previously existing against pasteurized milk by such sensational catchwords and slogans as "Pasteurized milk is only another name for rotten milk." The advocates of sterilized milk in their zeal have oftentimes seemed to overlook the fundamental importance, *on other grounds than those of communicable disease transmission,* of having milk produced and handled throughout, in all the processes from cow to consumer, in the cleanest manner possible.

The ideal of the raw milk advocate is in a phrase: Milk from absolutely healthy cows, milked and handled exclusively in all its processes of collecting, marketing and distributing by individuals known to be in perfect health and incapable of transmitting disease, who at the same time observe the most rigid precautions as to personal cleanliness and cleanliness of utensils, who keep the milk throughout these steps at a very low temperature, and who deliver it in the shortest possible time to the consumer. This ideal finds its nearest approach to realization in the well-known "certified milks."

But every year of accumulated experience has demonstrated certain obstacles to the fulfillment of this program. The chief ones are these: —

1. That only a very small percentage of milk is so produced, because such milk is an unusually expensive milk to put on the market, and thus becomes impracticable for the average consumer.

2. That even these precautions do not guarantee the consumer against possible infection through milk. For example, the numerous instances in which a certified herd has most unexpectedly been found to have become extensively infected with tuberculosis, or such an occurrence as the great septic sore throat epidemic of Boston and vicinity in 1911, coming, although not from a certified supply, from a milk supply which was guarded by most elaborate precautions to insure a high degree of cleanliness and freedom from infection.

As Rosenau pithily expresses it, "One of the features of special interest concerning this outbreak was that this milk has always been a particularly clean, fresh and satisfactory supply. It is obtained from tuberculin-tested cows, under constant veterinary inspection, and the milk itself is subjected to

daily chemical and bacteriological tests. The milk is bottled at the dairy, the bottles sterilized, and all reasonable and *many extra* precautions are taken to insure its cleanliness and purity. It emphasizes the lesson that raw milk is apt to be a dangerous milk."

In fact, a careful and impartial study of the entire question will force any one to the practical conclusion that efficient disinfection is our only certain safeguard against infectious disease transmission through milk.

Efficient disinfection can be conceivably brought about by either heat or chemical action. There is no chemical process that we can discover that will efficiently disinfect milk without at the same time either producing chemical changes that render the milk entirely unfit for food, or else will introduce substances into the milk, as formaldehyde, that are in themselves deleterious.

Disinfection by heat may be either by actual boiling or by pasteurization. Disinfection by boiling produces certain chemical changes in the composition of milk, due largely to the coagulating of the milk albumen, which materially affects the flavor. Nevertheless, it is the procedure of choice in many European countries.

Since it has now been firmly established that pasteurization properly carried out is an absolute protection against pathogenic micro-organisms that may have accidentally infected milk, and since this process, carried out at proper temperatures and with proper subsequent handling of the milk, produces no change in the flavor or appearance, and no chemical changes of any practical consequence, pasteurization has become firmly established in America as the disinfection process of choice.

6. Pasteurization as a Means of Infectious Disease Prevention.

Pasteurization is considered in another section from various angles. Here our only interest in the process is the question of its efficacy as a means of preventing the transmission of communicable diseases through milk.

In the past many arguments have been raised against pasteurization. Unfortunately, in its beginning as a commercial practice in the milk industry of this country, pasteurization

received a bad name which the easily demonstrable benefits of the process have never been able to live down.

Pasteurization, as first resorted to in America, was in spirit, if not in law, a plain, palpable fraud. The process was originally utilized by dealers to keep dirty milk in a marketable condition longer than could otherwise be done. This naturally had the effect of aligning health authorities against the process. It was many years before sanitarians generally came to appreciate that this abuse of pasteurization was not any real argument against the benefits of pasteurization.

Then several authorities brought forward the argument that the process of heating milk produced certain chemical changes that rendered the milk less suitable for infants' diet, and that long-continued use of pasteurized milk tended to produce the disease known as infantile scurvy. Several years of heated discussions on this point succeeded in effectually settling this objection by proving (1) that the disease, infantile scurvy, was comparatively rare; (2) that it was at least doubtful whether pasteurization of the milk was the cause; and (3) that it could be both prevented and cured by the addition of fruit juices, or animal or vegetable albumin, in simple and easily digestible form, to the child's diet.

With this objection disposed of the opponents of pasteurization took refuge in the claim that heating milk killed the "life" of the milk. No one has ever been able to demonstrate just what the "life" of milk is in the sense in which the objection was originally used. New milk has a certain inhibitive power over bacterial growth, but this is lost after eighteen hours, or, in other words, some time before the ordinary market milk of our larger cities can possibly reach the market. Milk is "dead" and begins to decompose from the moment it is drawn from the udders, — sometimes before milking.

There are several so-called enzymes, or ferments, in milk the exact nature of which is still in controversy, but none of these are in the least affected by the temperature to which milk is heated in the process of pasteurization except two that, so far as any one can determine, have no effect upon health.

Another objection that has more weight, and that has often been raised against pasteurization, is that the process, by de-

stroying the lactic acid bacteria which normally bring about the souring of milk, destroys "Nature's danger signals." This argument would be much more effective if it were not for the fact that pasteurization at the temperature recommended, while it kills all disease germs, does not destroy all the souring bacteria. These will again multiply, and hence souring is only delayed, not prevented, by efficient pasteurization at approved temperatures. Nature has no danger signal in milk. Sour milk is not harmful. Infected milk looks and tastes well.

The great and original objection to pasteurization — *i.e.*, that it promotes dirty, careless methods of milk production, and leads milk handlers to believe that it is immaterial how much cow dung or other filth gets into the milk — is still the one chiefly used by the opponents of pasteurization.

This entire objection falls to the ground if once the sanitary prerequisite is firmly established that milk must be reasonably clean to be eligible to pasteurization.

When the positive benefits of pasteurization are considered, the evidence is so overwhelming as to admit of no answer. Proper pasteurization kills all the germs of the communicable diseases of man that can possibly be transmitted through milk. Pasteurized milk is the only safe milk.

Pasteurized milk in this sense means milk heated to not less than 140 degrees, nor more than 150 degrees F. (preferably 145 degrees), for not less than twenty minutes (preferably one-half hour), then *cooled* quickly and kept cool and free from contamination until delivery to the ultimate consumer.

Milk so treated is just as digestible, just as nutritious and just as palatable as the raw milk, and this is the simplest, cheapest and best method of making milk safe from the danger of transmitting communicable diseases. The certain protection that pasteurization gives against infection with bovine tubercle bacilli in itself far outweighs all the economic, esthetic or sanitary objections that can be brought against the process. Furthermore, the process is, as Rosenau says, too important a health matter for its methods of carrying out to be left under the care of any other agency than that of the health authorities.

No one denies that, except when pasteurization is carried out in the final container, there is always a more or less remote possibility of the milk being reinfected, before it reaches the

ultimate consumer, from direct contact by a convalescent or a chronic disease carrier. With this limitation clearly understood, the efficiency of pasteurization as a disease-preventive process becomes the more remarkable when we reflect upon the astounding fact that, in spite of the hundreds of well-authenticated outbreaks of infectious diseases definitely proven to have been due to infected milk, and in spite of the ever-increasing percentage of pasteurized milk placed on the markets of the large cities of this country in the past twenty years, there has never yet been an important outbreak of a communicable disease that could be attributed to a pasteurized milk supply. For this statement we have no less an authority than Assistant Surgeon General Trask of the United States Public Health Service, under whose direct personal supervision the prevalence of communicable diseases, not only in this country but throughout the world, has been carefully studied for many years. Writing under a very recent date, Nov. 24, 1915, in response to an inquiry on this point, he states: "I have no record of any epidemic or outbreak of any size that was milk-borne on a pasteurized milk supply."

There have been a few instances in which an outbreak of communicable diseases has occurred on a milk supply which was alleged to have been pasteurized, or on the route of a dealer who handled both pasteurized and unpasteurized milk, from which the impression at first was that the milk came from the pasteurized source. In every instance on record in which such an occurrence has been investigated it has been found that no real pasteurization of the milk supply had been carried out. Either pasteurization was claimed when it had never been in effect, or else the machinery for carrying out the pasteurization was at the time of the outbreak out of commission either by accident or neglect. In certain of these instances, when the pasteurizing machinery got out of order, there was at least a strong suspicion that the pasteurizer may have acquired only a sufficient amount of heat to act as a bacterial incubator rather than as a bacterial sterilizer. The ever-present possibility of such accidents occurring in pasteurization, even although experience has proved them to be extremely infrequent, makes the need for efficient governmental supervision of pasteurization doubly essential.

C. MILK AND INFANT MORTALITY.

By the "infant mortality rate" we mean the number of infants under one year old who die as compared to the number born during that year. To know this we must know how many are born and how many die. The registration of both births and deaths is so incomplete in the United States that these figures are not obtainable for our country as a whole.

The Massachusetts figures, which are fairly accurate, are steadily improving.

Year.	Rate per 1,000 born.
1900,	156.7
1905,	139.0
1910,	135.6
1914,	104.53

In Boston the figures were, in 1910, 126 per 1,000 born; in 1914, 102.23; from 1909 through 1913 the average annual rate was 120 per 1,000 born.

In foreign countries the data obtainable are not quite so recent.

Country.	Years.	Average Rate.
Scotland,	1893–1902,	127
Norway,	1893–1902,	94
Sweden,	1893–1902,	99
France,	1893–1902,	158
Austria,	1895–1900,	227
Russia,	1890–99,	272
England, Wales,	1901–05,	138
New Zealand,	1910,	68
	1911,	56
	1912,	51

Our Massachusetts rate is not by any means the highest in the world, but it cannot be considered in the same class with

that of New Zealand, the lowest. We pride ourselves on our knowledge of science and scientific methods, yet in the matter of the reduction of infant mortality we are not even in the advance guard of the nations.

The causes of infant mortality are many and complicated. The following table shows the relative importance of the principal causes as stated by Dr. Emmett Holt of New York, an eminent authority, by the Maryland State Board of Health, and by Drs. Koehler and Drake of Chicago.

	Holt.	Maryland State Board of Health.	Koehler and Drake.
Percentages due to: —			
Diarrhœal diseases,	28.0	38.5	39.8
Congenital defects and childbirth,	31.3	17.1	24.0
Pneumonia, bronchitis, influenza,	18.5	14.7	20.6
Acute contagia,	5.4	5.0	3.2
Tuberculosis,	2.0	2.5	1.6
Venereal diseases,	1.2	–	1.3
All other causes,	13.6	22.2	4.8

Cow's milk as an infant food might enter prominently into the following of these causes: Diarrhœal diseases, acute contagia and tuberculosis.

Its significance in the acute contagia and in tuberculosis are considered in another portion of this report.

According to the majority of authorities, failure on the part of mothers to provide breast milk for their children appears to be on the increase throughout the civilized world.

Spargo says: —

> The modern mother is growing more and more unable to nurse her child at her breast. For some subtle reason this function of maternity is being atrophied in civilized women; and the higher their civilization the less able are they to suckle their children. With the vast majority of women who find themselves unable to discharge this important maternal duty the trouble is not social or economic but physiological.

Dr. Holt tells us that among the well-to-do and cultured mothers not more than 25 per cent. of those who have earnestly and intelligently attempted to nurse have succeeded in doing so for as long as three months. Among the poorer classes in

our cities there is also a marked decline in nursing ability, although not yet to the same degree as among those higher in the social scale.

On the other hand, according to Dr. Herman Schwartz of New York, based on observation of 1,500 babies, 96 per cent. of the mothers were able to nurse their babies for one month or less. He says: "This proves very conclusively that if care is taken from the very start most women can do something toward nursing their children."

With every failure in the ability of a mother to nurse her child comes the demand for a substitute food for the infant. No ideal substitute has been found. Many milks have been used which approximate more or less closely to human milk in composition. Because of the quantity needed, because of the establishment of the dairy industry in this country and its consequent availability, because it can be modified comparatively readily to a close approximation to human milk, cow's milk has been and will be our main standby. It then follows that if we are to provide cow's milk as a substitute food for our infants we must see to it that this substitute saves as many infants' lives as possible and kills as few as possible.

The composition of human milk differs from cow's milk, as follows: —

	Protein.	Fat.	Milk Sugar.	Mineral Matter.
Human milk, ...	1.6	3.4	6.1	6.20
Cow's milk, ...	3.2	3.7	4.9	0.75

The greatest difference is in the protein content. Protein is the muscle-building element. In cow's milk it is present in a greater quantity in proportion to the other elements than the human body requires. To get a sufficient amount of milk sugar from unmodified cow's milk a large excess of protein and a lesser excess of fats would be taken. On the other hand, to secure proper amounts of protein would be to take an insufficient supply of fats and a still less sufficient supply of milk sugar. Again, the protein in cow's milk is of a different chem-

ical composition from that in human milk; it forms a tougher curd and is more resistant to digestion. The fat in cow's milk is in larger globules and has a higher melting point than the fat in human milk. Raw, unmodified cow's milk is an unnatural and badly balanced food for infants. By proper modification the proportion of the different elements can be brought to correspond to the proportions in human milk, but the chemical variations in the proteins and the fats cannot be brought to correspond.

Human milk as administered by breast feeding requires no intermediary handling or storage, and is taken into the child's stomach with a minimum of contamination and of bacterial content. Cow's milk must be handled by milkers, transportation agents, dealers and mothers or attendants with ever-present opportunities for contamination by dirt and disease germs. It must be stored in containers, and is more or less often transferred from one container to another with the attendant dangers from dirty vessels or diseased handlers. The necessary time elapsing between milking and feeding gives great opportunity for increase in the bacterial content. All these factors occurring at all stages of the route of the milk from the cow's udder to the baby's stomach — on the farm, on the road, in the distributor's hands and in the home — furnish opportunities to render a clean milk dirty, a pure milk infected.

Milk, whether from the cow or the woman, is produced at body temperature. Both, as secreted, are naturally sterile. Both may be infected in the process of milking. Bacteria multiply but little at a low temperature, but milk, at summer temperature, becomes an excellent culture medium for many varieties. The question whether the germs of communicable diseases of man may multiply in milk to any great extent is still disputed. However, it is not disputed that disease germs *live* for varying but considerable periods of time in milk, when once introduced, and are transmitted by it to their natural environment, the human body, and there multiply and produce their specific disease.

Cow's milk, unless properly cooled and kept cool during the time elapsing between production and consumption, becomes loaded with bacteria and their products. Reasonable protec-

tion, therefore, demands this prompt cooling and continuous holding at the safe temperature.

Dirt, with its accompanying dangerous chemical and bacterial elements, may be introduced into the milk at any or all stages of its journey, — from dirty udders, teats and flanks of the cow; dirty hands of the milker; dirty methods of milking; dirty stables and pails; dirty washing water; dirty milk machinery; dirty distributors, wagons and bottles; dirty utensils in the home; dirty attendants; dirty mouths in the babies, etc.

Cow's milk for infants is a primarily ill-suited food that is in constant and continuous danger of becoming a positively toxic food at every stage of its existence as milk. If, however, the natural supply of infant food fails, something must be provided in order to prevent starvation and death, and it is our office to see to it that the substitute is as little toxic as possible.

The Place of Cow's Milk as a Cause of Infantile Diarrhœa.

In wholly breast-fed babies it can have no effect; in partly or wholly bottle-fed babies it is of primary importance.

The proportion of breast-fed to bottle-fed babies in our infant population is an unknown quantity.

It is stated that in Norway and Sweden nearly all infants are breast fed; in Scotland 80 to 85 per cent. are breast fed; in France there is little breast feeding; in Russia little breast feeding; in Austria breast feeding is predominant in the upper classes, artificial in the lower; no definite statements regarding England and Wales could be found, but all comment indicated a large percentage of bottle feeding; in this country the general impression is that breast feeding is steadily declining.

In Chicago, during July, August and September, 1911, according to reports from visiting nurses, there were, among the infants visited by them, 15,861 breast-fed infants and 5,477 bottle-fed infants. Dr. W. H. Davis states that in Boston, in 1911, out of every 100 babies 68 were breast fed and 32 were bottle fed, and that of the 621 deaths of infants from diarrhœa and enteritis in Boston during the same period 87 were breast fed and 534 were bottle fed. In other words, 6 bottle-fed infants died of intestinal trouble to 1 breast fed, and there were

not half as many bottle-fed babies in the city as there were breast fed.

Authorities the world over agree almost without exception that the mortality of bottle-fed infants is frightfully in excess of the mortality of breast-fed infants, and that this excess of mortality is in great measure due to intestinal disturbances or communicable diseases caused by contaminated or infected milk.

The health of the cow is the first factor in pure milk production. No one would expect to get a milk absolutely free from dangerous possibilities from a sick cow. Of about the same importance is the health of the person taking care of the cow. Our records of communicable diseases, showing how in many instances a case of disease at the dairy is spread along the milk route in epidemic form, prove the actuality of this danger.

Cow dung in the milk is at least undesirable from the standpoint of the average consumer. Many of our best pediatricians believe that it is a positive danger. An uncleaned cow or an uncleaned milker, an uncleaned stable or a stable cleaned at the time of milking, uncleanly methods of milking, straining, cooling or storing milk, — all give frequent opportunities for this contamination.

The use of simple and easily learned, clean methods protect milk from dirt to an astonishing degree; clean cows, clean stables, clean milkers and the small-top pail work wonders.

The dirt that does the most harm in milk is bacterial. Milk at a temperature approaching body heat is a very perfect culture ground for many bacteria. Counts of bacteria content show a steady and extraordinary rapid increase in the number of bacteria in milk that is held warm, and this increase is measured largely by the length of time it is so held. On the other hand, milk at 50° F. or lower is not a good culture medium, and milk that is cooled immediately after milking to that temperature and held at that temperature can be stored for a comparatively long time without showing great increase in its bacterial content.

In the milk business proper cooling of the milk and holding it cold is not a complicated process, but like many other simple

processes it is difficult of execution because it has to be perfectly carried out to insure safety. Failure to cool immediately and to hold cold constantly and continuously spells bacterial growth. To be safe it must be held cold through the whole journey from the cow to the baby, in the dairy, during collection and transportation, at the dealer's, during distribution and at the home before use. It is a long chain, and, like all chains, if a weak link develops it will break there and be worse than useless.

Of late years there has been much legislative discussion aimed at the control of the production of milk. Cattle and dairies are more or less thoroughly inspected, and milk dealers advertise and show to the public as well as to the inspectors the cleanliness and safety of their methods of handling milk. By constant watchfulness a certain measure of protection is being secured up to the point of delivery of the milk at the home. After that point is reached the elements of human ignorance, poverty and carelessness come into the question where they are beyond the control of legal remedial measures. That a very large proportion of the contamination of milk at the present date occurs in the home seems to be the common conclusion of investigators.

Mr. W. E. Kreusi, of the Milk and Baby Hygiene Association of Boston, testified in 1910 as follows: —

> The committee regards the milk situation very much better with respect to conditions at the producer's end, and very much better as to conditions in the contractors' and peddlers' hands, than in the hands of the ordinary consumer.

The effort to save babies' lives through baby feeding and milk stations has gained enormous headway, and has produced very definite and highly satisfactory results. As these organizations were originally instituted their object was to furnish a pure, clean milk as a food for infants. A notable example of this was the establishment of milk depots in New York through the philanthropy of Mr. Nathan Strauss. It soon became evident that this did not solve the problem. As one of Dr. Price's nurses in Detroit put it, "To successfully combine milk with a baby you must take care of the baby as well as the milk."

The home conditions, the care of the milk at home, and the general hygiene of the baby were evidently as important or even more important than the exceptional original purity of the milk. The follow-up nurse was introduced, who went to the home, advised sanitary improvements and taught the ignorant mother the simplest principles of the hygienic care of the baby as well as of the milk. Dr. Price of Detroit reversed his infant mortality rates — made them lower in the hot months than they had been in the cold — by the use of nurses alone, not nurses combined with milk stations.

In the past the cause of summer diarrhœas in infants has been almost always charged up to bad milk. It was admitted that other factors entered in, but it was believed that they did so to so small an extent as to be comparatively negligible. Prompted by the results obtained by the work of the visiting nurse, studies are being made that are showing the unexpectedly large measure of importance of factors other than sanitary milk.

Dr. Arthur Newsholme, an eminent English sanitarian, in a study of 1,259 infants during an epidemic of infantile diarrhœa, found that artificial feeding was the habit, either wholly or in part, with the large majority of cases of the disease, showing the value of breast feeding; but also he found that babies fed on condensed milk were twice as susceptible to the disease as were those fed on fresh cow's milk, showing that it was rather the artificiality of the feeding than the cow's milk as a food that was responsible. Also from this series it might well be argued that cow's milk was the best substitute food if a substitute must be used.

Prof. C. E. A. Winslow of New York finds that, in the case of infants, bad ventilation and indoor heat are almost as important causative factors in diarrhœal as they are in respiratory diseases; that heat alone has a marked effect on the baby. In a series of infants who were either breast fed or fed from bottles under the best conditions he found that while 80 per cent. of them did well during the winter, only 60 per cent. did well during the hot months, showing the important definite effect of heat alone.

Holt and Park say: —

The depressing effects of great atmospheric heat, *i.e.*, a temperature in the neighborhood of 90° F. or over, were very marked in all infants no matter what their food. Those that were ill were almost invariably made worse, and many who were previously well became ill.

Dr. J. W. Shereschewsky of the United States Public Health Service, in discussing the effects of heat on infant mortality, concludes that the action of heat as a direct cause has been greatly underestimated; that it is the indoor heat common in poor housing conditions that is responsible; that the responsibility of dirty and stale milk has been overestimated, although breast feeding must still be regarded as a most, if not the most, important preventive of the summer deaths of infants; that future activities for the prevention of infant mortality must concentrate themselves to a greater extent on the improvement of housing conditions, and on education regarding the proper care of babies in the summer.

Infants are delicate machines. It is not necessary that they should be bottle fed to endow them with a high death rate. Incomplete development, inherited constitutional weaknesses or disease, excessive heat, high humidity, poor ventilation, improper clothes, accidents and the various communicable diseases are all factors in it.

The experience of this State seems to be that the causes of infant mortality cannot be charged in the majority of cases to the condition of the milk supply as delivered at the door. Unquestionably this is the cause in many cases of death, but not in a preponderance of them.

Dr. Gerstenberger of Cleveland, after stating that 300,000 under one year of age die yearly in the United States, says he wishes to call your attention emphatically to the fact that at least 50 per cent. of these are dying without any real cause, simply from ignorance of the parents, their advisors, — they are the physicians and nurses, — and from ignorance of the public at large. Most parents, especially the more poorly situated, have but the slightest conception of the proper hygiene of the child and its surroundings. The big bulk of advisors of the parents — the physicians and nurses — are too ignorant to train and advise parents "because not especially trained for this." The public does not appreciate how many lives are

lost, and does not know that the power to remedy the conditions at fault lies in its hands, and its hands alone.

Dr. Newsholme states that while infections resulting in infantile diarrhœa are possibly introduced on the farm, in his opinion the majority are of human origin, and closes his summary with the following: —

> In balancing up the above facts and considerations I have no hesitation in adhering to the opinion stated in many of my past annual reports, — that diarrhœa is mainly due to domestic infection.

On the other hand, many believe with Dr. Henry L. Coit of Newark, N. J., that our reliance should be placed on the production of a safe, raw, "certified" milk, controlling it by flawless inspection from the cow to the consumer; that if we provide an absolutely safe milk to begin with we minimize the dangers in the use of cow's milk as an infant food.

What are the remedies?

1. We must insure a clean, safe milk.
2. We must educate mothers.

1. Insuring a Clean, Safe Milk.

Efforts to secure such a milk supply have occupied the Legislature a goodly amount of time in the past. It is obvious that hygienic conditions in the dairy, in transportation and in the sale and delivery of milk can be secured only by constant supervision. Where a reasonably safe line between expense and results can be drawn can only be determined by experience. It will be best to err on the side of safety. Since the health of the milk handlers is a matter of importance in the transmission of communicable diseases, and since many of these diseases are transmissible before identifiable symptoms appear in the patient, it follows that the most carefully inspected, "certified" milk may become infected in spite of the most faithful and detailed inspection. As long as human beings are fallible, so long will contaminating accidents be possible at any point between the cow and the final consumer.

Heating milk to the boiling point, sterilizing it, frees it from live bacteria. In Amsterdam, Holland, the entire supply of

the city is boiled to protect against epidemics. In Europe, in general, milk is cooked. Advocates of this system extol the absolute freedom from bacteria and the consequent safety of the milk. Opponents argue that there is a chemical change resulting from the heat that changes the digestibility of the milk and causes digestive disturbances in the consumer, and, in particular, results in infantile scurvy. Many experiments by European and American investigators seem to show that this viewpoint is not supported by fact to a demonstrable degree. This process does change the taste of the milk, pleasantly to some and unpleasantly to others.

Heating milk to between 140° and 167° F., and holding it at that temperature for twenty minutes, kills the germs of all the communicable diseases so far as we know them. This process is known as "pasteurization." The efficacy of pasteurization in the control of milk-borne epidemics has been frequently proved in the State. It certainly does kill the disease-producing bacteria, if properly performed. Advocates of pasteurization base their arguments on the results obtained in the reduction of infant mortality following the institution of the process. Opponents state that the rendering milk safe by this process puts old, stale, decayed milk on an even footing, from the standpoint of salability, with clean, fresh milk, and there is no escaping the conclusion that, in part at least, they are justified. They also argue that, just as in "cooked" milk, there is the possibility of resultant scurvy in the consumer. In this particular their arguments appear to be unsubstantiated.

In the Transactions of the Second International Congress on the Milk Industry, held in Paris in 1905, Dr. H. de Rothschild, speaking of infantile scurvy, refers to objections raised to pasteurization on the ground that it causes this disease. He says that a careful study made by him for ten years showed only 23 cases in the whole of France; and that he is forced to conclude that if such a process is effective in the reduction of gastroenteritis, tuberculosis and typhoid fever, to base an objection to its use on the ground that it may cause a disease that has occurred but 23 times in ten years is not valid.

One or more of these three methods of securing a clean, pure milk are used in communities the world over with success that is more or less perfect. The majority of observers seem to favor

a combination of thorough inspection followed by pasteurization, — not overlooking or belittling the immense advantage of clean production and distribution, but augmenting that by the additional safeguard of pasteurization.

Dr. Henry Helmholtz of Chicago says on this subject: —

> There are those who would prevent all infant mortality if they could only feed all children of the tenements a pure, clean, raw milk. There are those who would accomplish the same end by feeding them, one and all, pasteurized milk. In each case they do not realize that infant mortality is a very complex problem, and that either one of these things is only a small factor, and that when it comes to the feeding end of the problem perhaps the most important thing is not so much what is fed as the way in which it is fed.

2. Educating Mothers.

As pointed out earlier, the contamination of the milk after delivery at the home is perhaps our most common present source of danger. No matter how pure and clean the supply, dirt added there renders the article just as deleterious as dirt added at any point previously, allowing only for the length of time between pollution and use and its proportionate bacterial growth. The mother who lets milk stand in a dirty pitcher in the sun for an hour or two, then pours it into a stale pan and puts it, uncovered, into a half-cooled refrigerator full of stale articles of food, and who goes through the long list of dirty methods of getting it into a baby's uncleaned mouth, is just as crassly ignorant or as criminally careless as the unhealthy producer who milks unhealthy and uncleaned cows in a dirty stable into dirty utensils, and the results to the infant are just as fatal.

We have laws and regulations which, according to our experience, are controlling the producer and the dealer to some degree, — many believe to a large degree, — but we have no way of reaching by legal means the consciously, or unconsciously, dirty woman in her home. The dirtiness is both visible and invisible, whether added by the producer or the housekeeper. There is no excuse for visible dirt in either case; it can be explained in only one way. Bacteriological dirt is not visible, and its presence may be due either to ignorance, to carelessness or to a wilful disregard of teaching. Women do not want their babies to die. When they are told where

the danger lies, and really believe that it does lie there, there is not much wilful disregard left. If the teacher can check up how well her instructions are being carried out there is not much room for carelessness. Most women with a young baby have not much time to go to school, nor can they leave their babies unattended while they do; therefore the school must be made to come to them.

So far we have evolved just one agency that answers these requirements, — the visiting nurse. The mother believes that the nurse knows what she is talking about: that she is not visiting her to make capital out of her, but to protect her baby; that she is a woman and cannot help loving babies; in short, she gives her her complete confidence. The nurse's visits are frequent, and the mother does not have much time to get rankly careless between them. At each visit the nurse brings the school to the home in lessons graded and fitted to the personal intellectual capacity of the woman.

Combine this system of education with a pure milk supply and we have the framework of our present-day methods in the attempt to reduce our infant mortality rate.

Associations and institutions all over the civilized world are using this method with a success so universal and so generally appreciated that no statistics are offered.

Summary.

The infant mortality rate is still higher than it should be, — higher than the investigators feel is inevitable. A still undetermined part of this excess is due to the quality of infant's food and the method of its administration. Breast milk is the natural food for the infant. When this maternal function fails a substitute food is required. Modified cow's milk is the common substitute, although it has inherent qualities that make it an imperfect food for infants. The supply for our cities must be brought from a distance. It may become polluted at any time between its secretion in the cow's udder and its digestion in the stomach of the infant. To make it reasonably safe it should be controlled by inspection and pasteurization up to the point of delivery at the home, and controlled after delivery by the education of the mother in hygienic methods.

D. THE NUTRITIONAL VALUE OF MILK.

After trying to digest the mass of conflicting evidence in the various aspects of the danger to the public health from milk, — a subject that from the nature of the evidence obtainable must be insusceptible of definite proof, — it is a pleasure to approach a subject in which some definite facts can be stated. Further, it appears to us that, especially in popular discussions of the milk question, the emphasis has been generally laid on these dangers, passing over the enormous value of milk to the human race with a very light touch; therefore it is doubly a satisfaction to register our appreciation of the unique place held by this sterling and indispensable food.

The universal use of milk as an ingredient of a large proportion of the products of the kitchen has perhaps made us lose sight of its prime individual value as a complete food in itself, and of the fact that it is the only single article of our foodstuffs which is so constituted, and is in itself so balanced and complete a ration, that human life can be sustained on it alone for a long period. For infants human milk is *the perfect food*. As referred to elsewhere in this report, a substitute food is frequently called for because of the failure of the maternal supply. As also stated, for economic reasons and because of custom, cow's milk is the usual substitute in this country. Cow's milk and human milk are near enough alike in the proportion of their constituents so that by simple means — so simple that a person of average mentality can understand and carry them out — cow's milk can be made sufficiently digestible food for the average infant. This is particularly true in cases where the mother has been able to nurse her child long enough to get him well started in life. With many infants, however, the chemical differences between the milk of the cow and of the woman render cow's milk, however modified, an unsuitable food for them.

As compared with the corresponding constituents in human milk, the proteins in cow's milk are more abundant and form a tougher, less flocculent cord, which is less easily penetrated and dissolves more slowly in the digestive fluids. The proportion of casein in the proteins is larger, and of lactalbumin,

smaller. The fats in cow's milk occur in larger globules and have a higher melting point. The sugar in cow's milk is less in amount, but identical in composition. The salts in cow's milk are more plentiful, and are those of lime and magnesium instead of those of potassium and sodium. Further, while both are alkaline when drawn, the cow's milk soon becomes acid and is usually so when used in the home. These chemical differences are inherent and unavoidable. As milk ages, further changes take place as the result of bacterial action, which are more or less deleterious to the infant. The conditions under which milk is transported and stored, and the time elapsing between milking and consuming, are directly concerned in these changes.

Faulty methods of production, distribution and receiving and caring for the milk at the home give opportunities for pollution of and consequent changes in the food value of milk. But in spite of these drawbacks modified cow's milk is the almost universal substitute infant food in this country, and is a generally adequate and satisfactory substitute. Its value to us as a food for infants cannot be overestimated. It is indispensable. As a possible negative proof of the value of cow's milk as infant's food the following is of interest: In a New England city of 120,000 inhabitants the total daily consumption is 27,000 quarts of raw milk, or .22 quart per capita, and 5,000 cans of condensed milk. The infant mortality rate is 171 per 1,000. In investigating the subject the local board of health states that raw milk is used for infants in very much smaller amounts than it should be, condensed milk, beer and coffee being used instead. Dr. Howarth of Derby, Eng., is quoted by Newman as follows: "Children fed on condensed milk show a very high mortality, viz., 255 deaths per 1,000 of children so fed." Physicians would not ordinarily advise the use of beer and coffee as a substitute for mother's milk. It is conceivable that the freer use of raw milk as a food for infants would result in a lowering of the infant mortality rate in this particular city.

The value of milk as a food for adults is, as a rule, rather under than over estimated. The digestive apparatus of the adult can disregard the chemical unsuitabilities with far more impunity than can the infants'. The worst feature of milk as a sole food for healthy adults is that it is too wholly digestible;

it does not contain in itself enough waste matter. The intestines of an adult have been accustomed to a good percentage of bulky, inert matter to serve as a vehicle for body wastes in their discharge. Milk itself does not provide this bulky waste, and for this reason may well be characterized, as has been done by Rosenau, as "too perfect food for the adult." Although perhaps "too perfect" for the healthy adult, this stricture cannot hold in the case of the sick adult. Here its easy digestibility and perfect balance as a food make it about as indispensable as it is in the case of the motherless infant. Dr. George W. Gay, in his testimony before the milk committee of the Massachusetts Legislature in 1910, emphasized very strongly the value of milk to the sick adult. He said, "Milk is the chief food of sick folks. We could not take care of sick folks if we did not have milk. The importance of milk as a food for sick people — adult sick people — cannot be overstated or overestimated."

Here, again, the pollution or contamination of the milk before it is swallowed may reduce its suitability as a food to the point of rendering it absolutely dangerous even to healthy adults; far more to sick ones.

And, again, the statements as to its food value hold good. Its place as a food for adults, particularly sick adults, cannot be overestimated; it is indispensable.

As compared with other foodstuffs its value is very high, so high that at present prices it is one of our cheapest of foods. As a readily understood comparison take the following: An adult man would need from 4 to 5 quarts of milk daily to supply his food requirements. The food value of 4 quarts of milk, if expressed in common foods, would provide the following amount as a daily supply: —

4 quarts of milk, ... { 4 eggs. / ¾ pound lean beef. / 2 pounds potatoes. / 1 pound cabbage. / ½ pound bread. / ¼ pound butter.

This is not offered as a balanced ration, but as a showing of the actual food value of milk. In view of this great economic value of milk as a food the waste that takes place in certain

[illegible] of the milk business is much to be regretted. The demand of the public for cream, as such, leaves a large amount of skimmed milk that has an uncertain market. Skimming milk removes about two-thirds of the fats, and hardly touches the sugars and carbohydrates, and the proteins are the muscle-building part of the milk. On the farm this skimmed milk is used in the family, fed to swine, calves or chickens, or [illegible]. When used for feeding, of course this valuable food is not wasted in its entirety, but even then it is using food of a very high nutritive value where a less valuable one might possibly be substituted, provided a suitable use could be found for the skimmed milk. Where it can be obtained in large quantities, large enough to warrant the investment, it is manufactured into casein, when the milk sugar is entirely lost.

In the aggregate large quantities of skimmed milk are wasted through the lack of intelligent demand for a valuable article. Determined by the chemical analysis, with the retail price of whole milk at 9 cents per quart, the actual *value* of skimmed milk is 4.6 cents per quart, and its retail market *price* at date is about 2 cents per quart. When people realize that for 2 cents they can get an article whose actual value is 4.6 cents, it would seem that the demand for it must increase, that the price will rise and the waste be checked.

SUMMARY OF PART V.

A number of the human communicable diseases are transmitted through milk. Those of the most importance in Massachusetts are tuberculosis, diphtheria, scarlet fever, septic sore throat and typhoid fever.

In tuberculosis the milk may be infected by the cow producing it, or by the human beings who handle it.

In the other four diseases mentioned, except possibly in the case of scarlet fever, the infection does not originate in the cow; the source is in the human handlers.

The amount of communicable disease transmission through cow's milk has been overestimated, but such transmission does occur in a degree of frequency which demands public protection.

The infection of milk with human disease germs may occur at any time between its secretion in the cow and its consumption.

In addition to infection with human disease germs milk may be otherwise polluted, or may decay to a degree that renders it an unsafe food for human beings.

To insure its safety as a human food two procedures of control are necessary.

First. — By inspection of cattle, methods of production and transportation, secure a supply that is pure, clean and fresh.

Second. — By the application of heat, destroy all disease germs that may be in it, whether they come from animal or human sources.

There are two methods of disinfection by heat in common use; (*a*) complete sterilization by boiling, and (*b*) partial sterilization, "pasteurization," by heating the milk to between 140° and 150° F. for from twenty to thirty minutes.

Both of these methods are effective. The partial sterilization, "pasteurization," seems to have fewer objectionable features, and is already established in this country as an accepted, successful process.

To obtain the most perfect results market milk, intended for human consumption as milk, should be pasteurized under the control of central authority and in the final container.

PART VI. THE GRADING OF MILK.

A. GENERAL DISCUSSION.

It is the prevailing opinion of those who have made a study of the subject that milk should be graded, although it is evident that the ideal system has not yet been devised. The system should aim, first, to aid in the production and distribution of milk which is safe from a health point of view, and which is of varied chemical composition.

The present Massachusetts statute contemplates to a slight extent the latter consideration by establishing a minimum standard of 12.15 per cent. for solids and 3.35 per cent. for fat, and the constitutionality of this type of statute has been repeatedly upheld by the Supreme Courts of this and other States on the ground that it is a health law. The courts recognized the fact that the milk of many cows did not come up to the standard, but were of the opinion that the people should be protected from an impoverished food. As a rule, where a minimum standard is established the quality of the milk adapts itself to the standard. Massachusetts, however, is an exception to this rule. The figures obtained from the samples collected by the inspectors of the Massachusetts State Board of Health show that the average milk sold in this State is 4.5 per cent. above the standard for solids and 14.6 per cent. above the standard for fat. The discrepancy is due to the fact that only a sample of skimmed milk can literally comply with the standard.

The following table shows the average composition of milk not declared adulterated, which has been collected and examined by the Massachusetts State Department of Health.

Year.	Number of Samples.	Solids.	Fat.	Solids not Fat.
1909,	4,242	12.78	4.10	8.68
1910,	5,032	12.85	4.02	8.83
1911,	4,341	12.83	4.00	8.83
1912,	4,516	12.66	3.89	8.77
1913,	6,154	12.69	3.84	8.85
1914,	5,502	12.70	3.82	8.88
1915,	6,765	12.68	3.82	8.86

Commercial grading of milk is to some extent practiced thus: Many dealers sell milk of different fat content, charging different prices, and others sell one grade of milk, charging a higher price than the usual commercial price by reason of its high fat content. No attempt, however, seems to have been made at official supervision of the sale of milk upon its chemical composition other than the necessary establishment of minimum standards.

Attempts have been made by different cities and towns to control the sanitary condition of milk by fixing by regulation a maximum bacteria content above which the milk cannot be sold. This is true of many cities and towns in Massachusetts, but beyond a few warning letters and some newspaper publicity but little attempt seems to have been made to strictly enforce these regulations.[1]

Standards of this sort are not to be construed as grading, because they are applied to the milk intended for use by the ultimate consumer, and the retail or wholesale dealer can easily devise means of controlling the final product by proper selection of milk in the one instance and by pasteurization in the other. The contractor will buy high-grade and low-grade milk at the same price, and by mixing these various grades of milk the fat and solid content of the mixture will more or less conform to the standard. The producer under these circumstances is paid by the quart, irrespective of the fat content of the milk, or, if any change in price is made, it is liable to be a reduction in the case of the low-grade milk. The contractor will also buy indiscriminately clean and dirty milk, and will mix, clarify and pasteurize it, thus giving no incentive to the farmer to produce clean milk.

There seems to have been no attempt made on the part of any State to establish and control the grading of milk, but the cities in New York State, under the provisions of the sanitary code of the New York State Department of Health, are attempting to do so. New York City, however, under the authority of the City Health Department, is maintaining successfully a grading system, based upon the bacterial content, whereby both the producer and the consumer are adequately compensated and protected. This system, which can be easily con-

[1] Brockton is a notable exception to this statement.

trolled when dealing with a congested population, prohibits the sale of raw milk unless of a quality resembling certified milk. This milk must be below a maximum bacterial content, must be obtained from tuberculin-tested cattle which are housed in stables of a minimum score on the special score card designed by the Department. All other milk must be pasteurized in apparatus approved by the Health Department, and in making the pasteurization regulations the commission has devised the scheme which makes the system a success, — by appealing to the commercial instinct of the dealers. If the bacterial content of the raw milk is above a certain fixed maximum this milk cannot be pasteurized and sold unless labeled "Grade C, for Cooking Purposes Only." In order to avoid the degrading of his product the contractor must select his dairies carefully, must pick out dairymen who furnish clean milk of a low bacterial content, and, in order to obtain sufficient milk to satisfy the demands of the retail trade, must pay more money to the dairymen furnishing such milk. Another important feature of this system is the regulation regarding two grades of pasteurized milk. The Grade A pasteurized milk is obtained from better stables and has a lower bacterial content before pasteurizing than the Grade B milk, and the public is willing to pay a higher price for the Grade A pasteurized milk. The sales of this grade are said to be increasing, and in order to comply with the demand the dealers made it a financial object for dairymen to produce milk of the Grade A quality of pasteurization.

The commercial pasteurization of milk should be inspected and carefully controlled by the health departments. Notwithstanding the fact that modern methods of pasteurization render milk safe, yet it is a fact that pasteurized milk is very easily contaminated, and after such contamination the growth of the bacteria is more rapid than in the case of raw milk less than twenty-four hours old. The reinfection of pasteurized milk can take place by means of a dirty cooling apparatus, dirty air in the cooling and bottling rooms, dirty bottles and dirty help. A man sick with typhoid fever working in a milk-bottling room can cause as much if not more damage than if he were on a farm engaged in milking cows. An occasional visit on the part

of the health authorities, with a thorough bacteriological examination of the milk in all stages of the process, will tend towards a safer milk supply than uncontrolled commercial pasteurization.

The pasteurization of milk should be permitted but once, in order to render the process entirely a health measure instead of being largely a commercial measure. This will insure the sale of milk of near-by production and milk not too old for consumption. The application of pasteurization was primarily designed in the case of milk for commercial purposes in order to enable dealers to market milk which, owing to age, could not otherwise be done. It should now be regarded as a necessary health measure, and its application be carefully studied from this standpoint rather than from a standpoint of pure commercialism.

Wherever milk is bought upon a fair equitable price based upon the fat content the producers invariably breed cattle giving milk with a high fat content, probably due to the fact that they receive more money per cow than if the milk is bought upon a flat rate per pound or per quart. It seems feasible that this system should be extended to selling at retail, and it would result in the paying of a higher price on the part of the consumer for high-grade milk, and, on the other hand, would encourage the sale of milk of a low fat content to those who could not afford to pay the higher price of milk high in fat. Under these conditions there would be a greater consumption and less waste than at present of that valuable food, — skimmed milk. Grading of this sort could be carried out only after repealing the skimmed milk law and permitting the sale of mixtures of skimmed milk and cream in all proportions, provided that the customer is aware of the fact and the per cent. of fat is stated upon each container. This is to some extent illegally practiced by many dealers who mix skimmed milk with high-grade whole milk for the purpose of producing a product but slightly above the standard, which form of adulteration if skillfully done may escape detection upon chemical analysis. This process, while reprehensible when applied to milk bought and sold by volume, is unobjectionable if the purchase and sale were based entirely upon the fat content.

If a grading system of this sort were instituted, the present standards of solids and fat should not apply to milk if the containers were labeled with the fat content, if (1) the milk were free from added water, and (2) if it complied with a minimum solids not fat standard based on a sliding scale of 8.7 per cent. in skimmed milk or milk with 0 per cent. fat, and of 0.0 per cent. in a hypothetical milk with 100 per cent. fat.

Table I. — *Prices and Values of Milk, Skimmed Milk and Cream.*

Skimmed Milk.

Composition.				Calories per Pound.	Purchased at 1 Cent per Quart plus Price of Butter Fat.					Sold at 2 Cents per Quart plus Price of Butter Fat.						Sold at 2½ Cents per Quart plus Price of Butter Fat.						Value per Quart at —		
					Price per pound of fat (cents).					Price per pound of fat (cents).						Price per pound of fat (cents).								
Fat (Per Cent.).	Proteins (Per Cent.).	Lactose (Per Cent.).	Solids (Per Cent.).		31	33	35	37	39	45	50	60	70	80	90	45	50	60	70	80	90	0.0055 Cents per Calorie.	0.014 Cents per Calorie.	0.0183 Cents per Calorie.
0.0	3.5	5.0	9.3	158	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	1.7	4.6	5.9
1.0	3.2	4.9	9.8	203	1.6	1.7	1.7	1.7	1.8	2.9	3.0	3.2	3.4	3.6	3.8	3.4	3.5	3.7	3.9	4.1	4.3	2.2	5.9	7.6
2.0	3.0	4.8	10.5	229	2.2	2.3	2.4	2.5	2.6	3.8	4.0	4.4	4.8	5.2	5.6	4.3	4.5	4.9	5.3	5.7	6.1	2.5	6.7	8.4

Whole Milk.

3.0	2.7	4.6	11.0	262	2.9	3.0	3.1	3.2	3.3	4.7	5.0	5.6	6.2	6.8	7.6	5.2	5.5	6.1	6.7	7.3	7.9	2.8	7.6	9.8
4.0	3.1	4.8	12.6	316	3.5	3.6	3.8	4.0	4.1	5.6	6.0	6.8	7.6	8.4	9.2	6.1	6.5	7.3	8.1	8.9	9.7	3.5	9.2	11.8
5.0	3.5	5.0	14.2	369	4.1	4.3	4.5	4.7	4.9	6.5	7.0	8.0	9.0	10.0	11.0	7.0	7.5	8.5	9.5	10.5	11.5	4.1	10.7	13.7
6.0	4.0	5.0	15.8	421	4.7	5.0	5.2	5.4	5.7	7.4	8.0	9.2	10.4	11.6	12.8	7.9	8.5	9.7	10.9	12.1	13.3	4.7	12.3	15.7
7.0	4.2	5.2	17.2	470	5.3	5.6	5.9	6.2	6.5	8.3	9.0	10.4	11.8	13.2	14.6	8.8	9.5	10.9	12 3	13.7	15.1	5.2	13.7	17.5

TABLE I. — *Prices and Values of Milk, Skimmed Milk and Cream* — Concluded.

Cream.

COMPOSITION.				Calories per Pound.	PURCHASED AT 1 CENT PER QUART PLUS PRICE OF BUTTER FAT.					SOLD AT 2 CENTS PER QUART PLUS PRICE OF BUTTER FAT.						SOLD AT 2½ CENTS PER QUART PLUS PRICE OF BUTTER FAT.						VALUE PER QUART AT —		
					PRICE PER POUND OF FAT (CENTS).					PRICE PER POUND OF FAT (CENTS).						PRICE PER POUND OF FAT (CENTS).								
Fat (Per Cent.).	Proteins (Per Cent.).	Lactose (Per Cent.).	Solids (Per Cent.).		31	33	35	37	39	45	50	60	70	80	90	45	50	60	70	80	90	0.0055 Cents per Calorie.	0.014 Cents per Calorie.	0.0183 Cents per Calorie.
8.0	3.4	4.7	16.8	488	6.0	6.3	6.6	6.9	7.2	9.2	10.0	11.6	13.2	14.8	16.4	9.7	10.5	12.1	13.7	15.3	16.9	5.4	14.2	18.5
9.0	3.3	4.6	17.6	526	6.6	6.9	7.3	7.7	8.0	10.1	11.0	12.8	14.6	16.4	18.2	10 6	11.5	13.3	15.1	16.9	18.7	5.8	15.3	19.6
10.0	3.2	4.6	18.5	567	7.2	7.6	8.0	8.4	8.8	11.0	12.0	14.0	16.0	18.0	20 0	11.5	12 5	14.5	16.5	18.5	20.5	6.3	16.5	21.1
15.0	3.0	4.3	23.0	769	10.3	10.9	11.5	12.0	12.7	15.5	17.0	20.0	23.0	26.0	29.0	16.0	17.5	20.5	23.5	26.5	29.0	8.5	22.4	28.7
20.0	2.8	4.1	27.5	972	13.4	14.2	15.0	15.8	16.6	20.0	22.0	26.0	30.0	34.0	38.0	20.5	22 5	26.5	30.5	34.5	38.5	10.8	28.2	36.2
25.0	2.6	3 9	32.1	1,176	16.5	17.5	18.5	19.5	20.5	24 5	27.0	32.0	37.0	42.0	47.0	25.0	27.5	32.5	37.5	42.5	47.5	13.0	33.2	44.0
30.0	2.4	3.6	37.6	1,378	19.6	20.8	22.0	23.2	24.4	29.0	32.0	38.0	44.0	50.0	56.0	29.5	32.5	38.5	44.5	50.5	56.5	15.2	40.0	61.6
35.0	2.2	3.3	41.0	1,579	22.7	24.1	25.5	26.9	28.3	33.5	37.0	44.0	51.0	58.0	65.0	34.0	37.5	44.5	51.5	58.5	65.5	17.4	45.8	59.1
40.0	2.0	3.1	45.6	1,783	25.8	27.3	28.9	30.5	32.2	38.0	42.0	50.0	58.0	66.0	74.0	38.5	42.5	50.5	58.5	66.5	74.5	19.7	51.7	66.5
45.0	1.8	2.8	50.1	1,985	28.9	30.7	32.5	34.3	36.5	42.5	47.0	56.0	65.0	74.0	83.0	43.01	47.5	56.5	65.5	74.5	83.5	21.9	57.7	74.0
50.0	1.6	2.6	54.6	2,188	32.0	34.0	36.0	38.0	40.0	47.0	52.0	62.0	72.0	82.0	92.0	47.5	52.5	62.5	72.5	82.5	92.5	24.3	63.7	81.0
55.0	1.4	2.3	59.1	2,390	35.1	37.3	39.5	41.7	43.9	51.5	57.0	68.0	79.0	90.0	101.0	52.0	57.5	68.5	79.5	90.5	101.5	26.5	69.6	89.2
60.0	1.2	2.1	63.3	2,593	38.2	40.6	43.0	45.4	47.8	56.0	62.0	74.0	86.0	98.0	110.0	56.5	62.5	74.5	86.5	98.5	110.5	28.7	75.4	96.6

TABLE II. — *Comparison of Prices and Values of Milk, Skimmed Milk and Cream by Various Methods of Computation.*

Fat (Per Cent.).	Calories per Pound.	1 Cent per Quart plus Fat at 31 Cents per Pound.	0.0055 Cents per Calorie.	1 Cent per Quart plus Fat at 37 Cents per Pound.	0.0063 Cents per Calorie.	2 Cents per Quart plus 45 Cents per Pound Fat.	0.0089 Cents per Calorie.	2 Cents per Quart plus 90 Cents per Pound Fat.	0.014 Cents per Calorie.	2½ Cents per Quart plus 80 Cents per Pound Fat.	0.0185 Cents per Calorie.
Skimmed Milk.											
0	158	1.0	1.7	1.0[1]	2.0	2.0[2]	2.8	2.0	4.6	2.5	5.9
1	203	1.6	2.2	1.7	2.5	2.9	3.6	3.8	5.9	4.1	7.6
2	229	2.2	2.5	2.5	2.9	3.8	4.1	5.6	6.7	5.7	8.6
3	262	2.9	2.8	3.2	3.3	4.7	4.6	7.4	7.6	7.3	9.8
Whole Milk.											
4	316	3.5[3]	3.5	4.0	4.0	5.6	5.6	9.2[4]	9.2	8.9	11.8
5	369	4.1	4.1	4.7	4.7	6.5	6.5	11.0	10.7	10.5	13.7
6	421	4.7	4.7	5.4	5.3	7.4	7.5	12.8	12.3	12.1	15.7
7	470	5.3	5.2	6.2	6.0	8.3	8.3	14.6	13.7	13.7	17.5
Cream.											
8	488	6.0	5.4	6.9	6.2	9.2	8.7	16.4	14.2	15.3	18.5
9	526	6.6	5.8	7.7	6.8	10.1	9.3	18.2	15.3	16.9	19.6
10	567	7.2	6.3	8.4	7.2	11.0	10.0	20.0	16.5	18.5	21.1
15	769	10.3	8.5	12.0	9.7	15.5	13.4	29.0	22.4	26.5	28.7
20	972	13.4	10.8	15.8	12.3	20.0	17.2	38.0	28.2	34.5	36.2
25	1,176	16.5	13.0	19.5	14.8	24.5	20.8	47.0	33.2	42.5	44.0
30	1,378	19.6	15.2	23.2	17.5	29.0	24.4	56.0	40.0	50.5	51.6
35	1,579	22.7	17.4	26.9	19.9	33.5	28.0	65.0	45.8	58.5	59.1
40	1,783	25.8	19.7	30.5	22.5	38.0	31.5	74.0	51.7	66.5[5]	66.5
45	1,985	28.9	21.9	34.3	25.0	42.5	35.0	83.0	57.7	74.5	74.0
50	2,188	32.0	24.3	38.0	27.6	47.0	38.7	92.0	63.7	82.5	81.0
55	2,390	35.1	26.5	41.7	30.3	51.5	42.4	101.0	69.6	90.5	89.2
60	2,593	38.2	28.7	45.4	32.8	56.0	45.9	110.0	75.4	98.5	96.6

[1] Purchasing prices of Turner Centre Dairying Association.
[2] Selling prices of Turner Centre Dairying Association.
[3] Boston contractors pay from 3 to 3.5 cents per quart for milk.
[4] Retail price of milk, 9 cents per quart at 3.7 per cent. fat.
[5] Retail price of cream, 60 cents per quart, at 30 to 40 per cent. fat.

Under such a grading system the price could be established in a manner similar to that now employed by the Turner Centre Dairying Association, — by paying a flat price per quart plus the value of the butter fat at an established price per pound.[1] The tables on pages 195 and 197 show the composition of skimmed milk, milk and cream, its food values in calories per pound, its cost and selling price calculated as described above, and its monetary value at a definite price per calorie. The data from which the composition of the milk has been computed can be found in the reports of the analyst of the Massachusetts State Board of Health, 1907–14. Judging from these computations and the data obtained from milk producers, the Boston milk contractors are buying butter fat from the farmer at about 31 cents per pound, and selling it at about 85 cents per pound to their retail trade.

A study of Table II. will show that the prices paid for cream are much higher than the increased food value should warrant, and that the skimmed milk is far more valuable than its market price. At the present price of skimmed milk (2 cents per quart) cream containing 40 per cent. fat is worth 22.6 cents per quart, and at the present price of cream (60 cents per quart) skimmed milk is worth 5.9 cents per quart. It is indeed unfortunate in these days of high food prices that such a quantity of valuable and highly digestible protein and carbohydrate food is wasted, owing to the excessive demand on the part of the public for cream.

The grading of milk by the New York City Health Department has been successfully carried out by limiting the number of bacteria before and after pasteurization, and the dealers now comply with the regulations without any serious objections; but on the contrary, no attempt has been made to establish by law or regulation the sale of milk upon its merits according to its chemical composition or food value. Any attempt to establish the latter form of grading would be in the nature of an experiment, but would in all probability be easier of operation and control than the bacteriological grading system, because

[1] The Turner Centre Dairying Association in October, 1916, was buying milk or cream at 50 cents per 100 pounds plus 37 cents per pound of butter fat, and was selling milk or cream at $1 per 100 pounds plus 45 cents per pound of butter fat. The sale of this milk or cream is almost entirely wholesale by this company.

the wholesale business in milk is now carried on in many places by payment upon the fat basis. The public could estimate to some extent the difference between different grades by the cream line, and furthermore, the fat content is more easily and accurately determined than the bacteria content, and is not so liable to fluctuation.

A requirement that all milk should be pasteurized could be easily carried on without hardship in but few cities and towns in Massachusetts, notably Boston, Cambridge, Somerville, Everett, Chelsea, Revere and Winthrop. Outside of these localities, with but few exceptions, the bulk of the milk sold is raw milk, and is sold by small dealers, many of whom own their own cows and market their own and their neighbors' milk. Many contractors in smaller cities do not resort to pasteurization, since their milk comes from near-by cities and towns, and pasteurization is therefore not a commercial necessity, and for them it would in many instances be an expenditure unwarranted from a commercial standpoint by the size of their business, although public health might warrant its application. The most efficient pasteurization from the commercial standpoint is the continuous process in which, by the holding system, it is necessary to have sufficient milk to take at least thirty minutes in flowing past a given point in the apparatus. The flash process can be operated with a smaller quantity of milk, as it requires but fifteen to forty-five seconds for the milk to pass from the mixing tank through the heater, over the cooler to the bottles. This process, while more expensive to operate because of the higher temperature to be attained, however, is open to the objections that the tubercle bacillus may not be killed in the short time it is exposed to the heat. It is, however, very efficient in reducing the number of bacteria, and causes no coagulation of the milk albumin.

The prohibition of the sale of raw milk from other than tuberculin-tested cattle could not be put into immediate operation in Massachusetts without causing a milk famine for a time at least, as undoubtedly 90 per cent. of the Massachusetts dairies supply milk from cows not so tested. The dairy scores of the Massachusetts State Department of Health obtained during 1913, 1914 and 1915 substantiate this statement

as do the data furnished by the State Department of Animal Industry; in fact, the figures furnished for 1915 indicate a much smaller percentage of tuberculin-tested cattle in Massachusetts than during 1914.

A requirement that all raw milk sold in Massachusetts should come from dairies with a relatively high score on the United States score card would put 50 to 60 per cent. of the milk producers out of business, and would cause a milk famine in all places other than large cities and towns where the sale of pasteurized milk is the rule, and would play directly into the hands of the large dealers. It is possible, however, to devise a modified score card where great stress is laid upon methods and less upon equipment than in the present score card.

If grading were entirely a matter of local option its adoption and operation would probably be carried on as extensively in the future as at present, since each city and town can now adopt such a system under chapter 744 of the Acts of 1914, and none have seen fit to do so. The local adoption of such a system in Massachusetts would lead to serious disturbances among dealers who sell the same product in several towns, and it would result in selling elsewhere the milk too poor to conform to the requirements of certain localities. The cost of operating the system would be so high that many cities and towns would be unable to enjoy its benefits. Such a system should be enacted by statute, and should be enforced by a central authority, — the State Health Department, — since the system has as its prime motive the health of the people.

B. RELATION BETWEEN SOLIDS AND FATS IN MILK.

The chemical analyses of milk made by the analysts of the Massachusetts State Department of Health have shown that a fairly definite relation exists between the percentage of solids and of fat. If in the average sample the per cent. of fat is much higher than the normal fat corresponding to the solids the sample is probably watered, and if much lower, the sample is probably skimmed. The greater the difference between the normal fat and the fat determined upon analysis the greater the probability of adulteration. The State Department of

Health has collected and examined during the past nine years 1,000 samples of milk of known purity from individual cows; that is, these cows were milked in the presence of an analyst or inspector of the State Department of Health, the milk of each cow was thoroughly mixed, and a sample was taken and examined in the laboratory. These analyses were made for the purpose of ascertaining the minimum percentage of ingredients below which milk could be declared adulterated; therefore the majority of the samples were taken from cows giving a heavy flow of milk and from those breeds known to give relatively poor milk. The relation between the solid and the fat content of the samples has been determined for each 0.1 variation of solids between 10 and 16 per cent., and for each 0.1 variation of the fat between 2.4 and 6.4 per cent., from which relation the average solids and fat for each 0.1 variation of either ingredient has been calculated. This table is too bulky for insertion, and a summary has been made and is presented herewith.

During the year 1913 the Department collected and examined 6,044 samples of commercial milk which could not be declared adulterated by the methods of analysis employed. The relation between the solids and fat content of these samples was determined in a similar manner to that employed with the known purity samples. The summary of this table is presented herewith.

Relation between Total Solids and Fat in Milk.

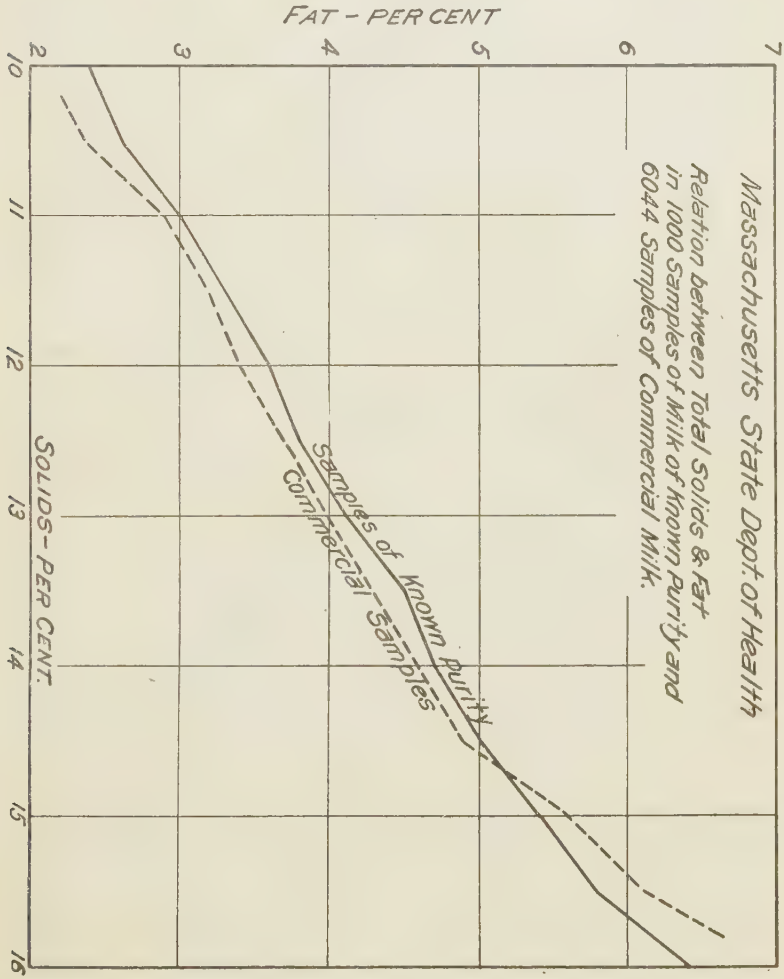
Number of Samples of Known Purity Milk.

Fat (Per Cent.).	Total Solids (Per Cent.).												Number of Samples.	Average Solids (Per Cent.).
	10.0–10.4	10.5–10.9	11.0–11.4	11.5–11.9	12.0–12.4	12.5–12.9	13.0–13.4	13.5–13.9	14.0–14.4	14.5–14.9	15.0–15.4	15.5–15.9		
2.0–2.4,	3	1	–	–	–	–	–	–	–	–	–	–	4	10.30
2.5–2.9,	11	31	14	5	–	–	–	–	–	–	–	–	61	10.81
3.0–3.4,	2	16	57	70	47	4	–	–	–	–	–	–	196	11.61
3.5–3.9,	–	–	15	39	98	94	19	–	–	–	–	–	265	12.30
4.0–4.4,	–	–	–	2	16	66	89	41	9	–	–	–	223	13.07
4.5–4.9,	–	–	–	–	–	7	36	41	37	13	1	–	135	13.72
5.0–5.4,	–	–	–	–	–	–	2	7	29	21	8	–	67	14.22
5.5–5.9,	–	–	–	–	–	–	–	1	2	7	11	7	28	15.05
6.0–6.3,	–	–	–	–	–	–	–	–	–	–	7	14	21	15.56
Number of samples,	16	48	86	116	161	171	146	90	77	41	27	21	1,000	12.75
Average fat,	2.67	2.88	3.21	3.39	3.66	3.99	4.36	4.58	4.83	5.26	5.61	6.02	–	4.05

Number of Samples of Commercial Milk.

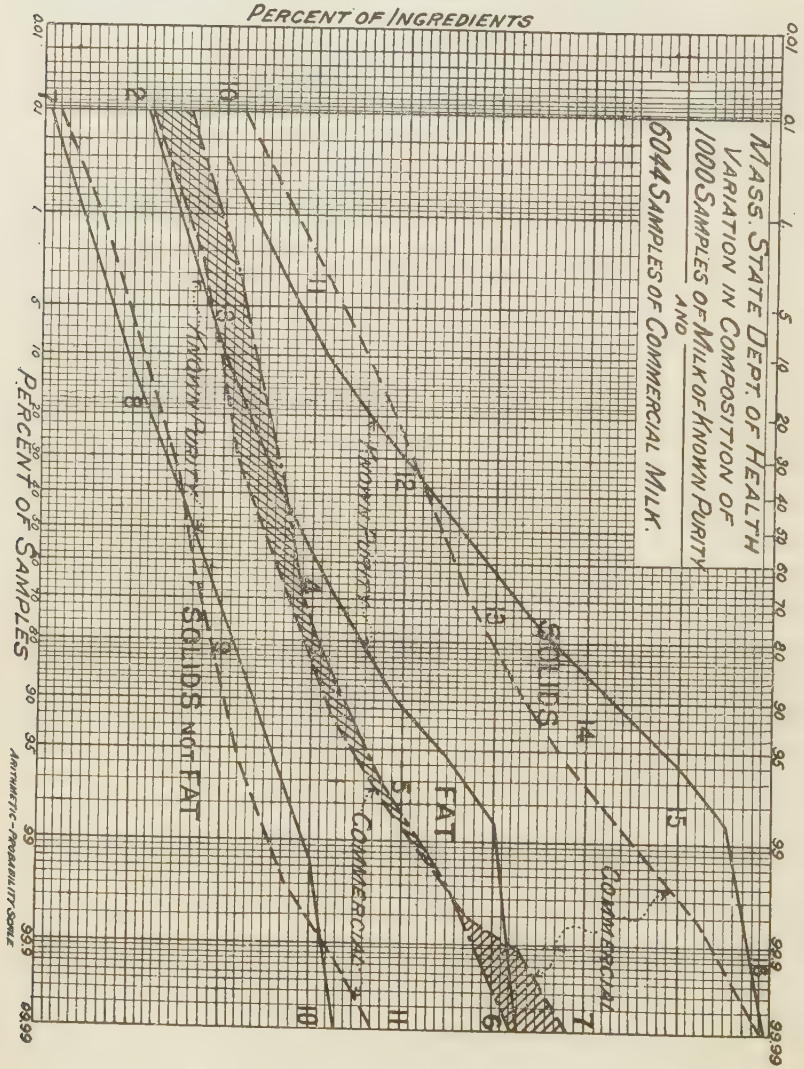
2.0–2.4,	2	4	1	–	–	–	–	–	–	–	–	–	7	10.61
2.5–2.9,	1	23	46	33	6	–	–	–	–	–	–	–	109	11.28
3.0–3.4,	1	11	101	399	530	130	5	–	–	–	–	–	1,177	12.06
3.5–3.9,	–	1	16	129	971	1,311	312	17	1	–	–	–	2,758	12.49
4.0–4.4,	–	–	1	–	58	417	656	262	25	–	–	–	1,419	13.10
4.5–4.9,	–	–	–	–	1	9	84	176	107	23	1	–	401	13.75
5.0–5.4,	–	–	–	–	–	–	4	24	39	35	11	2	115	14.33
5.5–5.9,	–	–	–	–	–	–	–	–	10	23	8	4	45	14.81
6.0–6.4,	–	–	–	–	–	–	–	–	–	–	5	1	6	15.25
6.5–6.9,	–	–	–	–	–	–	–	–	–	–	4	3	7	15.37
Number of samples,	4	39	165	561	1,566	1,867	1,061	479	182	81	29	10	6,044	12.67
Average fat,	2.75	2.83	3.09	3.28	3.47	3.78	4.08	4.47	4.82	5.24	5.72	6.03	–	3.81

After the averages had been computed it was found that the known purity samples up to 14.7 per cent. solids were relatively higher in fat than the commercial samples, but above this percentage of solids were relatively lower. The detection



of skimming is difficult when the fat content is between 3 and 5 per cent., and the differentiation between milk and cream is difficult when the fat content is between 5 and 7 per cent. These two conditions probably account to some extent for the difference between the two sets of averages. The curve of the average solids and fat is shown in the above chart.

At the request of Prof. George C. Whipple these analyses were plotted upon the arithmetic probability scale of Hazen and Whipple. The percentages are so arranged upon this scale



that if the data are obtained in sufficient quantity, and the variable follows the law of probability, the resulting curve will be a straight line. While the lines obtained in these instances are not straight, they are so nearly straight that we are jus-

tified in assuming that sufficient samples have been examined from which definite conclusions can be drawn.

In the probability chart presented herewith the abscissæ (horizontal dimensions) represent the per cent. of samples, and the ordinates (vertical dimensions) represent the maximum percentage of ingredients. For example, 20 per cent. of the known purity samples contained less than 11.6 per cent. solids, 3.3 per cent. fat and 8.2 per cent. solids not fat. Twenty per cent. of the commercial samples contained less than 11.9 per cent. solids, 3.1 per cent. fat and 8.29 per cent. solids not fat. Notwithstanding the fact that the solids were higher by 0.3 in the commercial samples, the fat was lower by 0.2, a difference of about 7 per cent. in the total fat content. Forty per cent. of the samples in each instance contained less than 12.35 per cent. solids, the known purity samples containing less than 3.7 per cent. fat, and the commercial samples containing less than 3.3 per cent. fat, a difference of 0.4, or about 11 per cent., of the total fat content.

Under the assumption that the average commercial samples should contain the same average fat as the known purity samples of the same total solids content, the per cent. of fat corresponding to the per cent. of solids has been calculated and inserted in the chart as a dot and dash line, and the space between the calculated and found fat percentages has been cross-hatched in order to emphasize the deficiency in fat of the commercial samples. When the fat exceeds 5.2 per cent., however, the commercial samples have a higher fat content than those of known purity, probably because samples of low-grade cream, claimed by the dealer to be milk when the inspector took the samples, are included in this portion of the chart. These samples, however, are less than 1 per cent. of the total number.

Ninety-nine per cent. of the average samples had less fat than would be expected if they are judged by the average quality of the 1,000 samples of known purity.

PART VII. EXPERIENCES OF OTHER LOCALITIES.

A. REPORT ON AN INVESTIGATION OF THE NEW YORK CITY MILK GRADING SYSTEM IN THE CITY OF NEW YORK.

On October 4 representatives of the State Department of Health visited the Department of Health of the city of New York, and saw Mr. Lucius P. Brown, chief of the Division of Foods, and Mr. Russel Sturgis, director of the Milk Inspection Department.

The present system of milk grading in New York City has been in operation for nearly three years, and is meeting with great success and producing good results. There are four grades: —

Grade A, { raw. / pasteurized.
Grade B, pasteurized.
Grade C, pasteurized.

All these grades must be properly labeled, and Grade C must be labeled "For Cooking Purposes Only." Milk can be pasteurized only once. The Grade A raw milk is substantially the same as certified milk. The Grade A pasteurized milk is of the same quality as Grade A raw milk, except the cows need not be tuberculin tested. The Grade B raw has been discontinued. The following table shows the grading system practiced in New York City: —

Grade A.

1. Raw.
   - Dairies: —
     - Equipment, ... 25
     - Methods, ... 50
   - Bacteria: —
     - 60,000 per cubic centimeter.
2. Pasteurized.
   - Dairies: —
     - Equipment, ... 25
     - Methods, ... 43
   - Bacteria: —
     - 200,000 per cubic centimeter before pasteurizing.
     - 30,000 per cubic centimeter after pasteurizing.

Grade B.

Pasteurized.
Dairies:[1] —
Equipment, ... 20
Methods, ... 35
Bacteria: —
1,500,000 per cubic centimeter before pasteurizing in city.
300,000 per cubic centimeter before pasteurizing in country.
100,000 per cubic centimeter after pasteurizing.

Grade C.

Pasteurized.
Dairies: —
Total, ... 40
Bacteria: —
300,000 per cubic centimeter.

If milk does not comply with the requirements of the rules and regulations it may be degraded. One of the principal features of this system is the requirement that milk containing more than a maximum of bacteria shall not be pasteurized. This makes it incumbent upon the milk dealer to see that the farmer is careful in milking, and that he cools the milk and delivers it as soon after milking as possible. A vast majority of the Grade B sold in New York City reaches the consumer not more than thirty-six hours old.

For the control of pasteurizing plants 18 country inspectors are employed and three city inspectors. These numbers vary from time to time. Each pasteurizing plant is supposed to be covered once per month, the inspector taking from 16 to 30 samples in each plant. He carries a special ice box in which are placed 1-ounce vials with a screw-capped metal cover, and carries a bundle of sterilized aluminum pipettes about 2 feet long.

In the ordinary inspection of a pasteurizing plant the inspector takes 4 samples from the mixing vat, 4 from the outlet of the holding tank, 4 from the outlet of the cooler, 4 from the bottles ready for shipment. The time the samples are taken is noted upon the sheet, and also the temperature of the milk and the bottle number. Under extraordinary conditions samples are also taken from the outlet of the clarifier, from the outlet of the heater, and, if more than one holding

[1] At present not enforced.

tank is employed, from each of the several tanks. The inspector, furthermore, makes a record upon a separate sheet of the name of the pasteurizing plant, the character of the pasteurizing apparatus, the temperature to which the milk was heated, the length of time it was held, the temperature of holding, the temperature at which it was received, and the temperature to which it was cooled. The bottles and cards containing the original data of collection are then transported either in person by the city inspectors, or by express by the country inspectors, to the bacteriological laboratory. From the samples taken from the mixing vat two dilutions are made — 1–100 and 1–10,000 — and a composite sample is taken for the isolation of the colon bacillus. The samples of heated milk are plated from dilutions of from 1–100, and the colon bacillus is isolated from the sample from the holder. In addition to this a sample of the water is sometimes taken, and a sample of can rinsings and bottle rinsings. For this latter purpose the inspector carries a bottle containing 50 cubic centimeters of sterile water. The contents of these bottles are poured into a bottle or can which is thoroughly shaken and the liquid returned to the original bottle. These samples are plated straight and 1–100 dilution. The results of the 4 samples are averaged, and the average figure taken upon which to base the opinion of the conditions at the plant.

The Department permitted access to the records, and the results of 50 inspections were copied, omitting, however, the name of the dealer. The following are characteristic results from pasteurizing plants operated under good conditions and under poor conditions: —

Plant operated under Good Conditions.

Character of Milk.	Bacteria per Cubic Centimeter.
Raw,	124,500[1]
At various stages of pasteurization: —	
From outlet of holding tank,	2,700[2]
From outlet of cooler,	275
From cans,	1,975

[1] Colon bacillus present in dilution of 1–100.
[2] Colon bacillus not present in 4 cubic centimeters.

Plant operated under Poor Conditions.

Character of Milk.	Bacteria per Cubic Centimeter.
Raw,	18,850,000[1]
At various stages of pasteurization: —	
From outlet of pasteurizer,	15,000,000
From outlet of holding tank,	100
From outlet of cooler,	15,000
From cans,	60,000[1]

[1] Colon bacillus present in dilution of 1–10,000.

The dealer was notified to label this product Grade C.

The bacteriological laboratory makes 300 bacteria counts per day. The work is done by 8 women who are paid about $40 per month each. They work under the direction of a woman who is a competent bacteriologist and doctor of medicine. She has nothing whatever to do with the reporting of the results to the milk dealers, and gives out no information regarding the work. The women who do the actual work are divided into two groups. They plate samples upon one day and count upon the next day, and the work is so arranged that if one of them is sick another can take her place. A large clerical force is used to compile the results. Dealers are not prosecuted, and in general a threat to degrade the milk is sufficient to induce the dealer to locate the trouble and make the necessary corrections.

On October 5 a commercial laboratory in New York City was visited, and the secretary and the director were interviewed. Inquiries were made regarding the practical application of the New York grading system. Both men were of the opinion that the system is all right, provided the regulations are reasonable. They criticized the recent regulations requiring milk dealers to sell milk containing not less than 8.5 per cent. solids not fat. They stated that grading had come to stay, but the ideal system had not yet been devised. The present conditions are infinitely better than former conditions, and no person would care to go back to the old system. This laboratory does a large amount of work for commercial milk dealers, and its

opinions would naturally be somewhat antagonistic to the Department of Health of New York City.

A milk contracting company was visited, and the chief veterinarian and a member of the sales department were interviewed. The veterinarian stated that the company maintained 11 veterinary inspectors and a local inspector at each country pasteurizing plant. The veterinarians make systematic visits to the dairies, each dairy being visited on an average of every six to eleven months. The local inspectors situated at the pasteurizing plants are expected to visit each dairy at least every month. These visits are made for the purpose of seeing that the cattle are healthy, as tuberculin testing is required for the sale of Grade A raw milk, but on the average more for the purpose of seeing that the dairies are kept in such condition that the raw milk will fall below the maximum bacteria requirement, above which it cannot be pasteurized without being degraded.

The company purchase milk upon the fat basis, but they sell their milk by the quart. On inquiring the reason for this difference the representative of the company stated it was necessary to do so in order to obtain milk of sufficiently high fat content so that it could be sold in New York without violating the requirements of the Department of Health. It also encouraged the production of high-grade milk and discouraged the production of butter on the farm. Shortly after they began to pay for milk upon the percentage of butter fat it contained, one farmer stated that he purchased butter for the first time in eleven years. The result of this method of buying has increased the quality of milk which the company have obtained from the farmers, because they are getting all the cream given by the cows. The milk is sold by the quart, the prices varying according to the bacteriological grades of the New York City Department of Health.

When asked whether or not the people of the city of New York appreciated the grading system, it was stated that the increase in the sale of Grade A pasteurized milk had been so rapid that they could not obtain caps for the bottles fast enough from the manufacturers.

In answer to an inquiry as to whether or not they had any trouble with the city Department of Health regarding the oper-

ation of the rules and regulations, it was stated that the company had no trouble with the Department of Health in any of their country pasteurizing plants.

The company stated that they began inspection work before the New York City Department of Health started the grading system. They are of the opinion that the dealer should be regarded as a factor in milk production, and be given proper recognition; and the larger the dealer the better for both the producer and the consumer. There is considerable competition between dealers in the producing territory, and this statement was confirmed by others. If the dairymen are all producing milk of good quality they will sell at the best prices. Naturally, the largest dealers will get the best retail trade, have less bad bills, and can therefore afford to give the most money for the raw milk and pick out the best dairies. The chief veterinarian of the company was of the opinion that the farmers under the best circumstances could not go into the retail milk business and make a profit. The sales manager stated that he was of the opinion that Massachusetts milk contractors did not inspect their dairies, and he knew that one Massachusetts company made no dairy inspection in the buying districts where they came in competition with the New York company. This was confirmed by a statement made by one of the New York City inspectors, that the dairies which were rejected by the New York company were accepted by the Massachusetts company. Both representatives of the New York company were of the opinion that grading has come to stay and will be extended.

They were asked regarding the grading of milk in cities in New York State other than the city of New York, and stated that the grading law, with a very few exceptions, would not be enforced by small local boards of health. These local boards of health made regulations which were not reasonable, by reason of the fact that they knew nothing about the business, and most boards would not enforce a grading law by reason of the fact that they had no money to do so, or did not care to institute any complaints against their neighbors. When asked what was the smallest possible quantity of milk which could be pasteurized without pecuniary loss neither man cared to give an opinion.

Another company was next visited, and the manager was interviewed. He stated that in his opinion the grading system was all right, but the regulations should not be changed quite so frequently. New regulations caused considerable trouble to the dealer, who would naturally purchase a large stock of caps for the milk bottles, and under changing regulations many of these caps became obsolete, and therefore had to be destroyed.

He believed the grading system is a good thing, and should be encouraged, but other communities should follow the New York City system as closely as possible, in order to obtain uniformity in methods of production and distribution. He was of the opinion that the public did not appreciate the grading system as it should, and bought milk upon the recommendation of other people, or of their family physicians, and in general bought the grade most suited to their means.

An assistant manager of this company stated that when the grading system was first established it was regarded by the dealers as an imposition. At present he has no objection to the system as a whole, but does object to the changes in the regulations, specifically the recent regulation requiring a minimum solids not fat of 8.5 per cent. He stated that some local regulations, specifically those of Buffalo, were more rigid than the New York City regulations, but in general, outside of the city of New York, little attempt was made to grade milk in New York State.

This company employ 11 inspectors, 3 of which are veterinarians. They spend their entire time in inspecting dairies, and each man inspects about 300 per month. The cost to the company is about $25,000 per annum, of which $15,000 is for salaries. The reason for the low expense account is due to the fact that the men live in their inspecting territory, and travel around by means of automobiles, which they own, the maintenance of which is paid by the company. The assistant manager thinks this is better than the other systems of inspection, where local inspectors are employed in the forenoon as can receivers and in the afternoon as inspectors. He believes that acting in the former capacity is beneath the dignity of an inspector, and the dairymen look upon it in this way; but when a man is inspecting all the time he commands the respect of the farmers. They buy milk upon the bacterial content and

upon the fat per cent. He thinks that the board of health should score the milk, and not the dairy.

This company also purchase small-top milk pails by carload lots, and sell them to their dairymen at cost price, which amounts to about 75 cents per pail. The inspectors, however, find that the farmers are often very lax in the use of such pails. A copy of a chart was furnished showing the bacterial content of the raw milk received in their New York pasteurizing plants each month during the past three years. This work was done by a commercial laboratory, about 10,000 samples being examined each year. The figures for 1914 are considerably below those obtained in 1913, and the figures for 1915 are, in all cases, below the requirements of the New York City Department of Health for Grade B pasteurized milk. This bringing down of the bacteria count was entirely the result of the inspections made and the advice given to the dairymen by the company. The assistant manager would not state definitely how small a quantity of milk could be pasteurized at a profit. He was of the opinion, however, that a dealer could operate a single tank set, in which the milk was heated, held and cooled, without removal from the tank.

On October 6 Dr. Hermann Biggs, Commissioner of Health for the State of New York, was interviewed. In response to inquiries relative to the operation of the grading system in New York State, Dr. Biggs stated that the system is working as well as could be expected, and a number of cities and towns which never had done any milk work were now beginning to do some work. The grades are the same as those adopted by New York City, but each city or town in the State has the right to make rules and regulations which may be more, but must not be less, rigid than those of the New York State Department of Health. Some cities, notably the city of Buffalo, have made regulations more rigid than the regulations of the State. Dr. Biggs was asked if there were any cities in New York State with conditions analogous to those of Boston, where one city is making the dairy inspections, and making some attempt to control the pasteurizing of milk delivered in eight or ten cities, which do practically nothing in the way of milk inspection. Dr. Biggs stated there were no such conditions in New York State.

B. REPORT ON A SPECIAL INVESTIGATION OF THE EFFICIENCY OF THE NEW YORK GRADING SYSTEM IN THE PRODUCING AREA.

Acting on information from the Connecticut Dairy and Food Commissioner, that he had heard a rumor that certain milk dealers in Connecticut were shipping milk to New York in violation of the New York City requirements, one of the analysts of the Food and Drug Division, in company with a Connecticut dairy inspector, investigated a plant shipping milk from Connecticut to New York City. The New York City system allows pasteurization plants to be licensed and ship milk to New York. Some are Grade A plants, which can pasteurize and bottle milk which comes up to the New York requirements for Grade A only. A Grade A plant cannot bottle milk falling below those requirements, and if for any reason any dairy shipping to such a plant falls to Grade B, the plant is not allowed to handle this milk with Grade A, but must ship it in cans as "C" milk to New York. In New York such milk can be pasteurized and bottled as Grade B.

In a similar manner a Grade B plant cannot bottle milk under the Grade A cap. Any milk coming to such a plant to be pasteurized must come up to the New York requirements for Grade B milk. Milk from Grade A dairies, if shipped to a Grade B plant, must be put out from such a plant as Grade B. The rumor relative to violations of the New York City milk rules was that some plants were handling both "A" and "B" grades, and it was suspected that some Grade B milk was being sent to New York with Grade A caps.

As far as the Connecticut dairy authorities knew, the only plant shipping bottled milk to New York with Grade A caps was Borden's Grade A pasteurization plant at Washington, Conn. The original plan of inspection was to visit this plant and also some of the dairies supplying it, but owing to a heavy snow fall a few days before, most of the roads were impassable and train service uncertain, so the Washington plant was the only place visited.

This plant receives milk from dairies scoring high enough to furnish Grade A under the New York requirements. These

dairies are scored twice a year by agents of the New York City Board of Health and by Borden's inspectors about once a month. Sediment tests are taken frequently at the plant so that the farmer can see how his milk compares with that of his neighbors. The investigators saw about 20 sediments from these tests, and all were unusually clean, some showing no sediment whatever. Samples are taken for butter-fat tests every day, as the farmer's pay depends on the grade of milk plus the amount of butter fat, Grade A milk with 3.80 per cent. fat being worth 4 cents per quart. If milk shipped to a Grade A plant falls to Grade B requirements, the shipper must either accept a Grade C price, which is 10 cents per can less than Grade A, or else ship to a plant handling Grade B milk.

At Washington bottles bearing Grade A caps, and others with Grade B caps, were seen which might lead one to believe that this plant was violating the regulations by handling milk from Grade B dairies. This, however, was not the case, as all the milk came from dairies up to the Grade A requirements, and could be bottled as Grade A if there were sufficient demand for this grade, which costs the consumer 1 cent per quart more than does Grade B. As there is no regulation forbidding the selling of a high-grade milk in place of a lower one, this plant was merely selling its surplus Grade A milk as Grade B, for which there was plenty of demand.

At the plant a record is kept of all milk received, source of supply, and amount of bottled milk sent away each day, as well as a record of the temperature and time of pasteurization. These records are inspected from time to time by the New York Board of Health. If these inspections show that milk has been received from Grade B dairies, the plant's license may be taken away and the milk of mixed grades may be destroyed.

The manager of the Washington plant thought that the New York City system of grading milk was the best one yet devised, and that other States and cities would adopt a similar one. With proper inspection of the dairies and the records ot the plants, there seems to be no reason why a State or city could not be reasonably sure of its milk supply. If a contractor tried to evade the law and sell low-grade milk for a higher one, he would surely be caught in less than a month, and lose

more than he could possibly gain. The whole system depends on proper and frequent inspection by competent men. The only possible disadvantage to such a system is that it practically forces dairymen to sell at wholesale rates unless they can make certified milk.

C. REPORT ON A SPECIAL INVESTIGATION OF THE NEW YORK GRADING SYSTEM IN THE PRODUCING AREA.

On Jan. 14 and 15, 1916, a representative of the Massachusetts State Department of Health visited a number of farmers in the vicinity of Utica, N. Y., to get their opinions of the present grading system of the New York City Board of Health for the milk supply of that city. These farmers deliver milk to three different stations, namely, the Muller Company of Marcy, N. Y., the Harlem Products Company of Clinton, N. Y., and the R. F. Stevens Company of Clinton, N. Y. Two of the farmers are grange masters, and most of them grange members. They are nearly all making Grade B, but a few were making Grade C, milk. None of them were producing Grade A milk.

The prices paid for milk were from $1.70 to $1.80 per 100 pounds for Grade B milk, and 10 cents per 100 pounds less for Grade C. In case of the Stevens station a fat percentage of 3.8 was also required for Grade B, as well as the other New York City grading system requirements; and 10 cents per 100 pounds was offered for every .1 per cent. fat over 3.8 per cent.

The farmers were asked particularly what objections, if any, they had to the system; also what they received for their milk, and if prices were satisfactory, and if not, what they considered fair prices; whether the inspection requirements were consistent with the prices allowed; whether the inspection was fair or too rigid for the grade supplied; what grade of milk they supplied and what determined the grading; if the inducement to supply a higher grade was worth the extra effort; whether the inspectors themselves were competent; and finally, whether the system was in any way satisfactory to them. Taken individually, their statements were as follows: —

1. *Mr. A, Marcy, N. Y.* — Mr. A is furnishing Grade C milk. He receives $1.70 per 100 pounds of milk. He said he, on the whole, was well

satisfied; that the treatment of the farmer depended largely on the contractors; that his station did not pay as well as some others; he did not care to retail milk, as customers were uncertain and the station took all his product. When asked why he did not get into a higher grade, he said the scoring requirements would not put him there, and for the little extra he received (10 cents per 100 pounds) it was not worth while.

2. *Mr. B, Marcy, N. Y.* — Mr. B is furnishing Grade B milk. He said at once that he was very much dissatisfied; that in his opinion the requirements should be for one grade, with all the farmers in that grade. He said most decidedly that the price received was not by any means sufficient. He receives at present $1.80 per 100 pounds of milk. Prices varied according to season from $1.05 to $1.85 per 100 pounds. When asked what he considered a fair price, he said $2 per 100 pounds for the winter months and $1.50 for the summer months would be satisfactory. He said the slight increase in price for milk of higher grade is not enough to make it worth while producing it. Some contractors give more than others; the farmer is at the mercy of the contractor. The inspectors are not practical men and do not understand their work thoroughly. He did not know of a good point about the system, and would prefer to retail milk, but had no near-by market.

3. *Mr. C, Marcy, N. Y.* — Mr. C is furnishing Grade C milk. He receives now $1.70 per 100 pounds. When asked why he was in this grade he replied that his barn was old and his score did not place him higher. He was asked about bacterial count placing him in grade, and he said he heard very little of this, and has only received reports of bacterial count twice; but the scoring of his barn was what placed him in Grade C, although his milk is clean. He considered that the bacterial count is extremely variable and uncertain, and often ran high for some unaccountable reason; also thought that scoring and bacterial count were not consistent. He said also that he knew that Grade B and Grade C milk were mixed at the station; whether it all went out as Grade B he was not certain, but it was likely that it did. He considered the inspectors not well informed or practical. Slightly rusty utensils were often complained of, yet rusty and dirty cans often came to him from the station. When asked in regard to prices he said emphatically that he did not receive enough money; that the price of help is double what it was ten years ago, and the price of milk has gone up but 25 per cent.; $2 for six winter months and $1.50 for six summer months would be fair prices in his opinion.

4. *Mr. D, Marcy, N. Y.* — Mr. D is furnishing Grade C milk, and receives at present $1.70 per 100 pounds of milk. In his opinion his milk is as clean as he can produce it, yet his score holds him in Grade C. He has heard but twice reports on bacterial count. The sediment test is taken once a week, and he considers this a good requirement. He said, moreover, that clean milk could be produced under almost any surrounding conditions if cows, utensils and the farmer himself were clean. When asked in regard to price he replied that it is not by any means enough;

the price of raw material, fodder, etc., should be taken into account when regulating price allowed for milk. Three and one-half to 4 cents per quart is the present cost of producing milk. He considered that the farmers are at the mercy of inspectors who do not know their business. He said that the farmers are fools to let this system continue, and not make some effort in their own united interests. He also knew that Grade B and Grade C milk were mixed at the station, and were probably sold as Grade B in New York City.[1]

5. *Mrs. E, Marcy, N. Y.* — Mrs. E is producing Grade B milk, and gets $1.80 now per 100 pounds of milk. She said at once that prices were not sufficient, and that the difference in price for a grade higher milk is not enough to make it worth the extra effort to produce it. The grading in her opinion is done entirely by score card, yet she received a report of bacteria count once when it ran high, which would perhaps indicate that this also has some influence on the grading. She considered the whole system in an unsatisfactory condition. A price of $2 per 100 pounds for winter months and $1.50 for summer months would be fair. She, moreover, intends to make cream from all of her milk and sell this rather than sell milk to the station under present conditions.

6. *Mr. F, Clinton, N. Y.* — Mr. F sells his milk as Grade B, and all milk sold to this station is of that grade. He is graded, as far as he knows, according to result of score card rather than bacterial count. He gets at present $1.70 per 100 pounds, and has received as low as $1.10 per 100 pounds. He said that he was not satisfied, and considers that $2 per 100 pounds for December and January, and $1.80 to $1.90 per 100 pounds the rest of the year, would be a satisfactory price. He also said that he had heard that farmers in some sections were considering putting up their own station owing to low prices received. Mr. F also objected to the returning of dirty cans from New York City to be washed at the station, rather than washing them in New York City. He said they were returned in an unusually filthy condition, and had heard also that often garbage, and in one instance a dead cat, had been found in one of the empty cans. The writer saw no evidence of this, however. Mr. F also sells some of his milk at retail in Clinton, N. Y., and finds this method yields him proper returns.

7. *Mrs. G, Clinton, N. Y.* — Speaking for her husband she said he delivers to station, selling on butter-fat basis as well as on grading. She has heard him say he is very much dissatisfied with prices and intends selling his cows.

8. *H. Farm, Clinton, N. Y.* — This farm is producing Grade B milk, which is also sold on the butter-fat basis, 3.8 per cent. required and 10 cents per 100 pounds allowed for every .1 per cent. over this. This farm gets now $1.85 per 100 pounds, and is not satisfied with prices, as no profit can be made with present cost of labor and feed. Two dollars for six months and $1.50 for six months per 100 pounds would be a fair price. This farm makes special effort to have a clean stable, yet cannot get into Grade A because of rigid requirements.

[1] Investigations made elsewhere show this statement to be absolutely without foundation.

9. *Mr. I, Clinton, N. Y.* — Mr. I had gone out of business because prices were not sufficient to warrant his selling milk. He said he had figured carefully and found that milk could not be produced on a paying basis unless $2.25 was received during winter months and $1.75 for the other six months per 100 pounds. To quote Mr. I: "When you feel you are losing on every quart produced you lack interest and feel antagonized, especially when inspectors are visiting. If inspection is rigid, and it is right that it should be, the farmer should get a price which is satisfactory. The New York Board of Health should regulate price paid to the farmer as well as grade the milk, and hold him to the requirements of his grade."

10. *Mr. J, Clinton, N. Y.* — Mr. J sells to Stevens station, giving price on butter fat as well as on grade. He sells Grade B milk at $1.85 per 100 pounds (now). He finds it hard, and said others also do, to produce milk above 3.8 per cent. fat and get a good quantity of milk. The variance in price is not satisfactory, and the price at any time is not sufficient. Two dollars in winter and $1.75 per 100 pounds in summer would be fair. Help is scarce and labor is high because hands will not work as many hours as formerly. Mr. J also stated that Grades B and C are mixed at the station; whether it is all sold as Grade B is not proved. He considered that the system is not well supervised at the station. It is his opinion that the grading results more from the scoring than on the bacteria count.

11. *Mr. K, Clinton, N. Y.* — Mr. K objected to the same price being given to farmers whose buildings were in bad condition as to one whose buildings are well kept. He sells Grade B milk. At present prices he cannot afford to hire help and buy feed; he therefore does all the work himself. The cost of feed has made a large advance in the last ten years. Mr. K also does not consider it fair to reduce the price in March or April, which is done, when it costs exactly as much to feed the cows, and the flow of milk is no greater at this season. As an example of the actual profit he gets he said it costs him $50 a month to feed 9 cows, and his receipts for the sale of milk were $110, not counting the cost of hay which he raised himself. If he hired help he would have little profit left from his milk business. Mr. K also considered that the requirement for cooling morning milk to 60° F. was a hardship for the farmer, as his facilities were not as good for cooling as those at the station, especially when the morning milk could be taken immediately to the station without cooling. Regarding the inspectors themselves, he said they are often not practical men. He told of one inspector who visited a farm where the cows were in a basement not easily found. The farmer found him in the hayloft looking for the cows. Naturally, all respect for the inspector was lost at once.

12. *Mr. L, Clinton, N. Y.* — Mr. L said at once and emphatically that the price received was not sufficient, and that he intended to go out of business. He sells Grade B milk. He said there was not enough inducement to produce better milk.

13. *Mr. N, Clinton, N. Y.* — Mr. N is not selling to a station, as he found it more profitable to make butter. When asked why some of the farmers did not produce Grade A milk he said that the requirements were

too rigid; even when the stable is clean and produces a very satisfactory product, still more is required, and the farmers will not meet the demands. He said the butter-fat premiums are not regular and are lowered without reason, perhaps due to a large quantity of milk on hand. Tests for butter fat made at the station do not always agree with those made by State inspectors.

It appears from the reports obtained from these farmers that the main objection regarding the New York City system is one of price. They do not get enough money to make the business pay. With one exception, the farmers were very much dissatisfied with the system. This man had been in this country but a comparatively short time, and was doubtless more easily contented, especially with prices, than an American farmer who would be in a position for better judgment. They state that the requirements, especially for Grade A, are so rigid as compared with the price offered for the extra effort that they do not consider it worth while getting into a higher grade. They claim that the inspectors themselves are often not competent, or if competent are not practical in their recommendations. It further appears from this investigation that there is a difference in the price paid for milk of different grades. There is no possibility of a producer making a low grade of milk and selling it for a higher grade.

D. COPY OF AN ARTICLE BY LUCIUS P. BROWN OF THE NEW YORK CITY HEALTH DEPARTMENT.

Conclusion and Summary.

1. In a city of large size it is impossible to so safeguard a milk supply confined to raw milk only, at any reasonable cost, as to insure its absolute safety.

2. The present system of milk control in New York City has justified itself by the absence of any considerable milk-borne epidemic of typhoid or other disease within the past two years, and by the ease with which any epidemic appearing can be now traced and controlled.

3. The New York system of milk control is necessarily a growth of many years, and is a development proceeding *pari passu* with the growth of knowledge in preventive medicine,

and particularly in knowledge of the principles of pasteurization.

4. The essential features of the New York City milk control system are —

(*a*) Pasteurization of all milk except that intended for special uses.

(*b*) In connection therewith bacteriologic standards properly administered.

(*c*) The labeling of all packages intended to go to the consumer.

(*d*) Constant inspection and supervision of the pasteurizing plants, which is an inspection that it is physically and economically possible to make efficient, in direct contrast with the attempt to handle an enormously large number of dairies and their employees, — a thing which can be done efficiently only at prohibitive cost.

To thoroughly understand the situation in New York City a short statement of the problem is desirable.

This problem is as follows: The control, both chemical and sanitary, of a milk supply for a city of about 5,000,000 people, with the aim not only of avoiding raising the cost of the milk, but, if possible, of actually extending its use as a cheap and easily digested food. Analysis of the milk supply shows that about 2,750,000 quarts of milk (including ice cream and condensed milk) are consumed daily in the city, furnished by 7 States and by 2 provinces in the Dominion of Canada.

It is estimated that about 50,000 dairies, about 440,000 cows and about 300,000 people are employed. This milk supply is handled in 60 city and 436 country pasteurizing plants, and there are 700 shipping stations for milk shipped raw to the city pasteurizing plants. The longest haul upon milk coming to New York is about 460 miles, and 80 per cent. of it over 200 miles.

The machinery at hand for controlling the milk supply is, of course, that under the control of the city Board of Health. Under the Constitution of New York State, and charter of New York City, the ordinances of this Board have the effect of laws; its powers are absolute and very broad, being limited only by the disposition of the city's financial boards to appro-

priate the funds necessary for the enforcement of the laws made by the Board of Health.

Following is a statement of the chief successive steps taken for the control of New York City's milk supply, which have led up to the system now in effect. The first step taken was in 1873, when "swill" milk was forbidden. In 1876 a code section was passed by the Board of Health forbidding watered milk. In this control, however, only the well-known lactometer of the New York City Board of Health was used. The producers finally learned how to beat this lactometer, and in 1895 chemical standards were set.

In 1897 a permit system was inaugurated for wagons and milk stores. In 1900 the cooling of milk in transit was begun, and there has been progressive improvement in this particular feature since that time. In 1902 one milk inspector was sent to the country to examine the sources of supply. In 1904 the milk inspection work, which was formerly done by the separate boroughs, was centralized in the hands of the city Board of Health, and a regulation was made that all milk must be kept, while in process of shipment or sale, at a temperature not greater than 50° F. In 1905 a systematic inspection of creameries was begun, and certain deficient ones were forced out of business. In 1906 the two inspectors then at work began the inspections of the dairy farms proper, and 16 new inspectors were added. Rules and regulations for the guidance of dairymen were made; and these appear to have been very well received by the dairyman, because of the help it gave him in regulating his own business. In 1907 a beginning of the exclusion system was made, the requirements being that weekly reports be made by creamery men and dairymen of contagious diseases occurring in their establishments, and they were required to cease handling their milk on occurrence of any such diseases. Failure to comply with this regulation meant the exclusion of their milk from the city. This principle was afterwards applied to other conditions. Milk stores were likewise regulated as to sanitary condition, and the score card system was adopted. A notable occurrence during this year was the appointment of the McClellan Commission of Physicians, in the report of which it was recommended that 100 country and 40 city in-

spectors be appointed. It will be noted that up to this time all the regulations were designed towards the securing of a satisfactory raw milk supply. In 1908 the first notice in the way of an official pasteurization was made. This regulated pasteurization, which had to be conducted under permit. During the same year the exclusion system was extended to unsanitary conditions at the creameries and dairies, and the wagon permits were made conditional on satisfactory report of conditions of production and distribution. Likewise in this year the classification of milk appears to have been first made. It was graded into selected, inspected, guaranteed and certified, all conditioned on inspection by medical societies and in accord with regulations of the Board of Health, taking cognizance of conditions of the cows, bacterial count, time of delivery, etc. Pasteurized milk was allowed to be sold under permit, and there were supplementary regulations on pasteurization passed.

The most notable occurrence of this year was the requirement that there should be attached to the container which reached the consumer, or from which the consumer, in the case of loose milk, was served, a tag indicating the location of the dairy or creamery and the date of shipment. In 1909 pasteurized milk was defined, and it was provided that the tags above mentioned must be kept for two months.

It will be noted that still up to this time little notice had been taken of pasteurization, but in 1910 a Board resolution (not having the direct effect of law) was passed, advising the public that all milk for drinking should be either boiled or pasteurized, and a tentative plan for grading was made based on the broad division of —

(*a*) Milk for infants to drink.

(*b*) Milk for adults to drink.

(*c*) Milk for cooking only.

These still form the broad, general basis for grading.

In 1911 announcement was made that after Jan. 1, 1912, all milk except special high-grade milk was to be pasteurized. The warning of this contemplated action was given so far ahead because of the necessity of making changes in the plants of milk dealers.

At the end of 1911 there was a conference participated in by dealers, the New York Milk Committee, the officials of the Department and certain physicians, which assumed that in addition to pasteurized milk two grades of raw milk, one for children and one for adults, could be sold, based on prescribed tests for tuberculosis in cows. These rules went into effect in 1912, and are indicated in table on page 228. This step was enabled by the advance of knowledge as to pasteurization, and, as will be seen, by recognition of the impossibility of properly inspecting a raw milk supply of this size. It was in no sense a backward step. In the year 1913, from the outbreak of a very bad milk-borne typhoid epidemic (1,100 cases in all), there resulted the abolition of Grade B raw milk, the pasteurization of all milk of this grade, and the establishment of bacteriologic standards throughout. There resulted likewise the simplifying of Grade A and the inclusion of cream in the pasteurization requirements.

This summary gives some indication of the weary road traversed by those men to whom is due the credit for the present excellent supply of milk for New York City. It will be noted that the essential features are pasteurization almost exclusively, and bacteriologic control of the raw and pasteurized milk, except in Grade A. It will be noted from table on page 229 that dairy scores are still used to assist in controlling the farms. This in no sense allows of the pasteurization of dirty milk. As a matter of fact, as is well known to those having to do with milk control, dirty dairies with their concomitant of careless and dirty methods almost invariably produce dirty work, while on the other hand the clean dairy produces clean milk. Because of this human factor a fair control of the condition of Grade B dairies may be effected through the bacteriologic examination of the milk. Grade A, which is naturally that milk requiring more supervision, is, of course, designed for the use of children, and must be, therefore, absolutely above suspicion. By requiring that no milk of a lower grade than "A" be handled in a Grade A plant, the necessary distinction as to that grade is readily secured. Mr. Russel Sturgis, chief of the Milk Division, of the Bureau of Food and Drugs of the Health Department of New York City, in an excellent paper published

in 1915, on "The Rôle of Dairy Inspection in Safeguarding a City's Milk Supply," and to which I am indebted for a very large part of what I have been saying, suggests that possibly at some future time, when the private inspection systems of the milk companies have been more completely developed, it will be found that the score card standard, at present neglected, will be appreciated as a measure of value. As a matter of actual fact, all companies handling milk desire of course to furnish Grade A milk, selling for the highest price. They therefore pay the farmer a premium for clean dairies and clean milk, and this operates as an incentive to the producer to improve his conditions.

It has often been objected to pasteurization, in the language of certain gentlemen of florid imagination, that the sale of pasteurized milk containing dead organisms — a sort of bacteria soup — is strictly parallel to the sale of a milk soup made from oysters of an uncertain vintage. I think experience hardly sustains this violent assumption. Whether it be true or not, however, the impossibility of handling a very large milk supply, such as that for the city of New York, without prohibitive cost for inspection, as well as without raising the cost of raw milk to the consumer to a prohibitive figure, can be readily appreciated. Moreover, a raw milk supply of this size which is absolutely safe is a matter of practical impossibility under present conditions; if for no other reason, because of the absolute impossibility of keeping out, in the enormous number of people through whose hands the milk supply goes before reaching the consumer, carrier cases of typhoid, diphtheria and the like.

In addition to the occasional farm inspection by the Department, farm inspection is promoted on the part of the companies by the necessary connection of conditions indicated by our inspections and counts, by the efforts of small companies trying to remedy faults, and by dairymen who are trying for the premiums for high dairy scores given by the companies. It may be further added that prior to 1912, and the inception of this system of milk control, one or more typhoid outbreaks every year in New York City which could be directly fastened on the milk supply were the rule, and usually these were of very considerable size.

In 1914 and 1915 there has up to date been only one small milk-borne epidemic of typhoid, promptly stopped by shutting off the milk supply, and only 90 direct cases in all. This occurred in a pasteurized supply, and appears to have been due either to a carrier case handling the milk after pasteurization, or, much more probably, to the water supply of the creamery becoming suddenly polluted.

A short description of the methods used by the Department may be of interest. It is required that the pasteurization be conducted between 142° F. and 145° F. for not less than thirty minutes; and, of course, cooling after pasteurization must be very prompt. In making his inspection the operator, of course, carefully examines all pipes and connections from pumps and other apparatus, taking everything apart if necessary to assure himself of cleanliness. He watches the sterilizing of the pipes and vats before use. In the actual handling of the milk he notes its condition as to dirt upon receipt, and watches to see that it is not exposed to dust. If the automatic temperature recorder is used its accuracy is tested at each inspection. These recording devices indicate the holding period very well except in case of continuous retarders, and in this type of apparatus the holding period is best ascertained by watching the speed at which the milk is dumped through. It is cooled, preferably to 45° or lower, and then the milk is immediately bottled or canned for shipment. By taking the temperature of cooling at frequent intervals the inspector is able to advise whether the hot milk is fed to the cooler too fast to obtain good results. Special stress is laid on the cleanliness of bottles and cans used for holding pasteurized milk. For this a sterile water control is used in the bacteriologic examination, and inspectors are kept closely informed of all results, their personal effort being of great value in this connection. Water samples for this purpose are transmitted to the laboratory for a count in the same way as the milk samples, 50 cubic centimeters of sterile water being used for washing each can or bottle. The accepted standard is 1,000 total bacteria in each 50 cubic centimeters so treated for bottles and 10,000 for cans.

Schedules for inspection are so arranged that samples of milk are taken during inspection of pasteurizing plants at certain

intervals. I quote from Sturgis's paper previously mentioned, as follows: —

> Four samples are taken at each of the various steps, and from those four individual samples an average is obtained which fairly reflects the quantity of the milk and also serves as a check upon the thoroughness of pasteurization. Usually these samples are taken from (*a*) the raw milk; (*b*) at the outlet of the holder, or after the milk has been heated and held; (*c*) from the outlet of the cooler; (*d*) from bottles or cans that have been filled for shipment. These samples are thoroughly chilled, packed in ice, and shipped in the milk car to the city terminal, where they are collected upon arrival and taken to the laboratory.

Our present inspection force consists of 20 country inspectors and 12 city inspectors. The country inspector's duty consists in the inspection of plants as just mentioned, and of dairies. Grade A dairies are inspected three times a year, and as much oftener as possible. Other dairies are inspected when the occasion allows. All inspections of dairies and creameries are recorded on score cards of the New York City form, the dairy cards being made in duplicate and a copy left at the farm. The pasteurizing plants are not scored, but are recorded on a special card where only changes from the last inspection are noted. This is also in duplicate, but the copy is sent to the office, and from there sent to the company responsible instead of being left direct with the company. On occasion the epidemiology of suspected milk-borne diseases is investigated by these country inspectors.

The city inspectors watch the supply to the point of delivery, that is to say, either to the retail store or to the customer. The stores themselves are inspected by inspectors of the Food Division of the Bureau of Food and Drugs, avoiding in this way duplication of work. Of the 12 city milk inspectors attached to the Division of Milk Inspection 3 are on bacteria samples, 5 on samples for chemical analysis, 2 on pasteurizing plants alone, and 2 on the large city dairies and on the pasteurizing plants in outlying portions. It is interesting to note here that within the city of New York itself there are over 100 dairies, with about 5,000 cows. Each of the bacteria squad takes 68 samples daily of raw milk going to pasteurizing plants, or of the pasteurized milk as offered for sale, making, all told (including 40

samples each for the two men on the pasteurizing plants), 284 samples of milk taken in the city for bacterial examination daily. A list of the various supplies is furnished to each man, and it is estimated that he will cover his field in three to four weeks. The chemical squad takes samples from wagons, about 65 a week in all. It will thus be noted that from 1,600 to 1,800 samples for bacteriologic and chemical analysis are taken per week for milk inspection purposes.

It is proper to state that for a considerable portion of the information given in this paper I am indebted to a monograph bearing the name of Lederle & Raynor, published by the Department of Health, and to the paper by Russel Sturgis, chief of the Division of Milk Inspection, heretofore alluded to.

It is perhaps unnecessary for me to state that my recent connection with the New York City Health Department has made it impossible for me to prepare this paper without much help from others.

1912.

Grade A.

1. Certified or guaranteed.
2. Inspected raw.
   - Dairies: —
     - Equipment, ... 25
     - Methods, ... 50
   - Bacteria: —
     - 60,000 per cubic centimeter.
3. Selected pasteurized.
   - Dairies: —
     - Equipment, ... 20
     - Methods, ... 40
   - Bacteria: —
     - 200,000 per cubic centimeter before pasteurizing.
     - 50,000 per cubic centimeter after pasteurizing.

Grade B.

1. Selected raw.
   - Dairies: —
     - Equipment, ... 25
     - Methods, ... 43
   - Bacteria shall not be excessive.
2. Pasteurized.
   - No dairy standard.
   - No bacteria standard.

Grade C.

For cooking (at first allowed raw).
Later required heated or pasteurized (no standards).

1914.

Grade A.

1. Raw.
   Dairies: —
      Equipment, ... 25
      Methods, ... 50
   Bacteria: —
      60,000 per cubic centimeter.
2. Pasteurized.
   Dairies: —
      Equipment, ... 25
      Methods, ... 43
   Bacteria: —
      200,000 per cubic centimeter before pasteurizing.
      30,000 per cubic centimeter after pasteurizing.

Grade B.

Pasteurized.
   Dairies: [1] —
      Equipment, ... 20
      Methods, ... 35
   Bacteria: —
      1,500,000 per cubic centimeter before pasteurizing in city.
      300,000 per cubic centimeter before pasteurizing in country.
      100,000 per cubic centimeter after pasteurizing.

Grade C.

Pasteurized.
   Dairies: —
      Total, ... 40
   Bacteria: —
      300,000 per cubic centimeter.

[1] At present not enforced.

E. REPORT ON INFORMATION GATHERED AT THE CONVENTION OF THE INTERNATIONAL MILK INSPECTORS ASSOCIATION.

The following information was obtained from the lectures and from talking with various local inspectors: —

Cumberland, Md. — All the milk comes from near home, within 30 miles. About one-half the supply is pasteurized and is not from tuberculin-tested cows. The standard is 12.50 per cent. solids, 3.50 per cent. fat. The price is 9 cents retail and about 4 cents wholesale.

Detroit, Mich. — Supply comes from within 100 miles, and all has to be pasteurized, but does not come from tuberculin-tested cows. The standard is 12.50 per cent. solids, 3 per cent. fat.

Seattle, Wash. — The supply comes from within 90 miles, and has to be either pasteurized or from tuberculin-tested cows. The standard is 3.25 per cent. fat and not over 200,000 bacteria. The wholesale price is 16 cents per gallon, and the retail price is 9 cents per quart. The United States score card is used and is relied upon absolutely. All employees in pasteurization plants have to be examined to see that they are not disease carriers.

Manchester, N. H. — Nearly all the milk comes from near home, though a little comes 200 miles. Some is pasteurized. It is not from tuberculin-tested cows. Retail price is 8 cents per quart, while the farmer received 3 to 5 cents per quart.

Washington, D. C. — In 1872 the Washington Board of Health required a permit for milk to come to the District from the surrounding country, but in 1884 this was stopped. In 1892 the Sanitary League was formed, and obtained a law compelling inspection before granting permits. This law was passed in 1895. This was the first system of licensing and controlling the milk supply, and is the one still used in Washington. Congress passes the milk law for the District of Columbia. The standard is 12.50 per cent. solids and 3.50 per cent. fat. All cattle have to be tuberculin tested.

Norjolk, Va. — Supply all raised within 7 miles, and about 40 per cent. is pasteurized and has to be from tuberculin-tested cows. Retail price is 10 cents. There is not much wholesale milk, but the price is about 20 to 23 cents per gallon. The fat standard is 3 per cent., and the inspector would prosecute below this figure. Certified milk must not contain over 10,000 bacteria. The inspector likes the United States score card. He does not believe in milking machines, as they spoil the cow.

New York. — The State standard and methods are used by all local inspectors except in cases where the cities or towns make regulations more drastic than that of the State. All milk has to be from tuberculin-tested cows or be pasteurized. Standard is 11.25 per cent. solids and 3 per cent.

fat. Milk is graded A, B and C raw and A, B and C pasteurized. For A raw milk the farmer must score at least 75, and the milk contain not over 30,000 bacteria. Herd must be examined each year. The score must be at least 25 for equipment and 43 for methods.

Grade B: Bacteria not over 200,000. Score must be 23 for equipment and 37 for methods, and herd must be examined each year.

Grade B, pasteurized: Score must be 20 for equipment and 35 for methods, bacteria not over 1,000,000, and the herd must be tested each year.

Grade C is anything from dairies scoring 40 points, but local authorities may make special regulations.

Grade A pasteurized must not contain over 200,000 bacteria before pasteurization.

The farmer receives $3\frac{1}{2}$ to 4 cents for A pasteurized grade, but for B grade is paid on a fat basis, which is lower. Retail price of A pasteurized and raw is the same, but most people prefer raw milk. About one-third of the milk is pasteurized by heating to 145° and holding thirty minutes. Heating too high breaks the cream line and spoils the looks of the milk.

Most of this information was obtained from the Auburn, N. Y., inspector.

In case of an epidemic the health officer notifies the State Health Department by telephone or telegraph. The State Department notifies the local authorities to shut off the supply, and it is done at once. The score card used in New York is a State one, but is a good deal like the United States card.

Mr. Purrington of New Hampshire says in New Hampshire the milk business is a side issue, and the farmer generally peddles his milk himself instead of selling to large dealers. He usually has a poor equipment and cannot afford to pasteurize. Mr. Purrington does not believe the State has any right to give definite orders, provided the milk is low in bacteria. The score should not be relied upon as much as bacterial count. Twenty per cent. of the cattle in New Hampshire have tuberculosis, and the tuberculin test is not general. The State is encouraging "inspected milk." This is milk inspected and licensed by the State, and the license can be revoked. Dealers producing "inspected milk" are allowed a special cap with the State Seal upon it, and receive 1 cent per quart above the regular price. About 20 producers raise "inspected milk." Prices of milk are 7, 8 and 9 cents.

Tests are now being made to determine the cost of producing "inspected milk."

Dr. Wiley says that where dairy interests control, the standard is low. Illinois has a low fat standard, — 3 per cent. He claims that New York and Ohio have much tuberculosis, as farmers are in control of Legislature and do not have proper inspection. Virginia has an inspection law, but not enough money to pay for condemned cows. He believes the United States should help States who try to stamp out tuberculosis. He believes milk should be graded, and the higher grade should receive the best price.

Dr. States of Detroit believes that all milk and its products should be pasteurized. He claims that heating to 160° for thirty minutes will kill the germs.

Professor Stocking of Cornell says that only a small proportion of milk drinkers get diseases from milk, but believes all this is preventable.

Mr. T. of Washington, D. C., a milk dealer who lost his license, does not believe pasteurization kills germs of tuberculosis.

The general opinion of those with whom the representative talked and the speakers was that all milk should be pasteurized, though some believed that milk from tuberculin-tested cows was safe if consumed raw. Dairy inspection and the use of the United States score card were recommended, although the score card should not be used as a standard for judging the milk, the bacterial count being more important. Mississippi and Washington do not allow disease carriers or those recently having disease to handle milk, and Seattle requires Widal tests from all employees in dairies. Montclair requires a health certificate every three months for employees in plants where milk is not pasteurized.

Mr. Stephenson of Washington, D. C., believes in milking machines where labor is scarce, but thinks it takes experienced men to use them. They do not pay for less than 20 cows. No special mention was made regarding different kinds of machines. One or two men believed in the use of clarifiers, though the use of them usually increased the number of bacteria.

No one knew of any portable forms of pasteurizers or cheap forms for small dealers. Co-operative or city plants were suggested, or the use of a wash boiler, as a cheap form of pasteurizer, in the home in case of epidemics.

The need of pasteurization or tuberculin-tested cattle and the medical inspection of employees in dairy plants were generally agreed upon, though the additional cost of the milk and the driving of small dealers from business were reasons advanced against these ideas. The United States score card seems to be considered the best standard there is for dairy inspection, and no changes were suggested.

F. DIGEST OF RECENT AMERICAN MILK LEGISLATION BY VARIOUS CITIES AND STATES.

The following milk laws and regulations were taken from the bulletins of the United States Public Health Service. They tend to show the attitude of health authorities toward (1) securing milk from cattle free from tuberculosis, (2) protection of milk against contamination from human sources, and (3) rendering uncertified milk safe for human consumption. The essentials of the various State laws applying to the protection of milk against contamination from human sources are as follows: —

California. — Requires by law that whenever a case of communicable disease occurs in the house of a milkman, milk distributor or dealer no milk is to be sold or distributed by him until the health authority designates a person to conduct the business and to see that no communication is maintained with the infected house except under official supervision.

New Jersey. — State Board of Health or its officers required to prohibit transportation of milk believed to have been contaminated from infected persons.

Colorado, Connecticut, Illinois, Maine, Maryland, Massachusetts, Michigan, Nebraska, New Jersey, New York, North Dakota. — Prohibit sale of impure milk or milk products produced under unsanitary conditions.

Idaho, Utah and Wyoming. — Forbid by regulation the sale of milk from quarantined premises.

Pennsylvania. — State Board of Health requires local health official to notify county medical inspector when milk is marketed from premises in which communicable disease prevails.

Colorado, Connecticut, Illinois, Maine, Massachusetts, Michigan, Nebraska, New Jersey, New York, North Dakota. — Persons in charge of dairy farms or dairies are required to report communicable diseases on their farms to health authorities.

Ohio. — Requires milk from infected places to be stopped.

California. — Requires pasteurization by law (act of May 4, 1915). No person, firm or corporation shall sell, exchange or offer or expose or have in its possession for sale or exchange any milk, cream, skim milk, ice cream, butter, buttermilk, cheese or other milk product as the case may be nor use the word pasteurize or any of its derivatives in connection with the sale, etc., unless the same and all products of milk have been treated by the process of pasteurization.

Durham County, N. C., has a regulation with special reference to communicable diseases in persons engaged in the production or handling of milk, which reads as follows: —

No person having tuberculosis, any venereal disease, or any other communicable disease shall work in any milk depot, dairy, or in any other place where milk or its products are handled. When typhoid fever, scarlet fever, diphtheria, small pox, measles, or chicken pox occur in a house or family of any one engaged in the handling of milk it shall be the duty of the owner or manager to notify the superintendent of health at once of this fact. Examination is required when communicable diseases are suspected. Any dairyman or milk dealer authorized under this ordinance or any employee engaged in any way in producing and handling milk or any member of their families, or any persons, residing in the house or on the premises occupied by such person, if suspected of having any communicable disease, may be required to submit to an examination at the hands of the superintendent of health. . . . Failure to co-operate with the superintendent in carrying out the provisions of this section shall be punished by the revocation of the permit held by such person, firm, or corporation.

For the securing of milk from cattle free from tuberculosis Richmond, Va., and Durham County, N. C., have the following regulations: —

Richmond, Va. — Beginning on and after September 1, 1915, no person, firm or corporation shall sell or offer for sale or otherwise dispose of within the city of Richmond or shall transport or carry for the purpose of sale in said city, or shall have in his or their possession with intent to sell or offer for sale or otherwise dispose of in said city, any milk or cream produced in whole or in part from cows which have not been demonstrated by the tuberculin test to be free from tuberculosis, said test to have been made within one year. Penalty for violation, . . . said milk or cream shall be condemned and destroyed by the food inspector or one of his assistants.

Durham County, N. C. — It shall be unlawful for any person, firm or corporation authorized under the provisions of this ordinance to operate or maintain a dairy for the production of milk, cream, or buttermilk for

sale or other distribution in the city of Durham or sanitary districts of east or west Durham, to use the milk of or from any cow that has not been tuberculin tested by the meat and milk inspector or other officers assigned to make such tests.

Spokane, Wash., has a regulation with regard to pasteurization which makes it unlawful for any person to deliver, sell or have or offer for sale or delivery in the city of Spokane, any pasteurized milk unless the same shall have plainly marked on each bottle a label bearing the inscription "Pasteurized Milk," and unless the same shall have been pasteurized within twenty-four hours prior to delivery to the consumer, etc.

The following are sections taken from the 1915 ordinance of Seattle, Wash. They are models that might well be followed by other communities.

Section 16. Provides that the Commissioner of Health shall have the right and is hereby empowered to condemn, render unsalable and return to possessor at his expense, milk to which any foreign substance has been added, etc.

Section 19. Provides that the Commissioner of Health shall have power to revoke all permits to receive milk within the city of Seattle from dairies, etc., outside of the city . . . whenever he shall deem such action necessary.

Section 31. Provides that it shall be the duty of the Commissioner of Health as often as he shall deem necessary to inspect all dairies . . . located outside the limits of the city of Seattle, from which milk is shipped or brought into the city of Seattle.

Section 34. Provides that the Commissioner of Health shall have the right and is hereby empowered to, and it is hereby made his duty to administer to all cows within the city of Seattle, an accepted test for the detection of tuberculosis, as often as he shall deem necessary. . . . All animals reacting to the tuberculin test shall be marked in a manner satisfactory to the Commissioner of Health for purpose of identification. . . . He is empowered to revoke permit issued to any person to sell milk within the limits of the city when any cow reacts to accepted test . . . and is not immediately disposed of satisfactory to the Commissioner of Health. Aforesaid test not required . . . when all the milk produced . . . is pasteurized . . . as defined in another section.

Section 37. Provides that it shall be the duty of all persons having charge or control of all dairies, etc., . . . to notify the Commissioner of Health of any suspected or positive case of typhoid fever, small pox, diphtheria, scarlet fever, tuberculosis, septic sore throat or any other communicable disease in any person upon such premises and no person suf-

fering from, or those coming in contact with such persons, etc., shall work in or about the premises where milk is produced, handled or offered for sale, for consumption.

SECTION 38. Provides that all persons handling milk to be sold in the city of Seattle, shall be subject to medical examination by the Commissioner of Health, free of charge. . . . In case of refusal to permit said examination . . . permits to sell milk in the city of Seattle shall be permanently revoked.

SECTION 44. Provides a penalty not exceeding one hundred (100) dollars, or imprisonment in the city jail not exceeding thirty (30) days, or both for violation of any of the provisions of the ordinance.

APPENDICES.

Appendix A.

TABULATION OF ANSWERS TO QUESTIONNAIRE ON MILK AND DISEASE FOR THE YEARS 1909-13.

Answers to Questionnaire on Milk and Disease, 1909–13.

Population, 1910.	City or Town.	Typhoid Fever.				Diphtheria.				Scarlet Fever.				Septic Sore Throat.			
		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.	
				Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.
1,692	Acushnet,	6	–	–	–	14	1	–	–	12	1	–	–	–	–	–	–
275	Alford,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9,894	Amesbury,	41	8	5	–	57	4	–	–	56	–	–	–	–	–	–	–
7,301	Andover,	25	6	–	–	33	1	–	–	68	1	–	–	–	–	–	–
2,107	Ashburnham,	–	–	–	–	10	6	–	–	7	2	–	–	–	–	–	–
885	Ashby,	2	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–
1,682	Ashland,	4	1	–	–	2	–	–	–	16	–	–	–	–	–	–	–
8,536	Athol,	21	2	–	–	75	8	–	–	126	2	–	–	–	–	–	–
16,215	Attleboro,	74	7	37	2	56	5	–	–	154	15	–	–	–	–	–	–
2,420	Auburn,	11	1	–	–	18	2	–	–	36	5	–	–	–	–	–	–
2,103	Avon,	10	–	–	–	24	1	–	–	24	–	–	–	–	–	–	–
2,797	Ayer,	–	–	–	–	40	2	–	–	23	–	–	–	–	–	–	–
4,676	Barnstable,	4	2	–	–	50	3	–	–	57	–	–	–	–	–	–	–

959	Becket,	13	2	–	–	9	–	–	–	5	–	–	–	–	–	–	–
5,542	Belmont,	7	–	–	–	30	4	–	–	71	–	–	–	–	–	–	–
18,650	Beverly,	69	13	–	–	92	9	–	–	162	3	–	–	–	–	–	–
5,648	Blackstone,	18	1	–	–	106	15	–	–	18	–	–	–	–	–	–	–
670,585	Boston,	2,765	349	46	3	11,023	733	–	–	8,748	324	286	–	800	11	800	11
2,474	Bourne,	–	–	–	–	3	–	–	–	2	–	–	–	–	–	–	–
718	Boxford,	3	–	–	–	–	–	–	–	25	2	–	–	–	–	–	–
8,066	Braintree,	21	3	–	–	33	2	–	–	90	5	–	–	–	–	–	–
56,878	Brockton,	364	24	–	–	561	50	–	–	710	23	–	–	14	–	–	–
2,204	Brookfield,	6	1	–	–	3	1	–	–	15	–	–	–	–	–	–	–
27,792	Brookline,	86	7	–	–	297	6	–	–	287	2	–	–	270	4	214	4
104,839	Cambridge,	370	43	70	6	1,488	130	–	–	1,250	27	20	–	900	33	900	33
4,797	Canton,	5	–	–	–	25	2	–	–	52	1	–	–	–	–	–	–
551	Carlisle,	2	–	–	–	7	1	–	–	6	–	–	–	–	–	–	–
1,663	Carver,	2	2	–	–	4	–	–	–	6	–	–	–	–	–	–	–
2,032	Charlton,	10	–	–	–	4	–	–	–	12	–	–	–	3	–	–	–
1,564	Chatham,	1	–	–	–	2	–	–	–	2	–	–	–	–	–	–	–
32,452	Chelsea,	134	19	29	2	379	18	–	–	537	9	30	1	–	–	–	–
1,508	Cheshire,	2	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–
1,377	Chester,	3	–	–	–	17	2	–	–	3	–	–	–	–	–	–	–
536	Chesterfield,	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
25,401	Chicopee,	151	8	–	–	191	20	–	–	218	21	–	–	–	–	–	–
13,075	Clinton,	34	4	–	–	104	10	–	–	32	–	–	–	–	–	–	–

Answers to Questionnaire on Milk and Disease, 1909–13 — Continued.

Population, 1910.	City or Town.	Typhoid Fever.				Diphtheria.				Scarlet Fever.				Septic Sore Throat.			
		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.	
				Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.
2,585	Cohasset,[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,741	Colrain,	2	–	–	–	–	–	–	–	14	–	–	–	–	–	–	–
637	Cummington,	2	1	–	–	20	1	–	–	20	–	–	–	25	–	–	–
9,407	Danvers,	64	9	–	–	64	6	–	–	76	–	–	–	–	–	–	–
4,378	Dartmouth,	29	1	–	–	18	1	–	–	32	–	–	–	–	–	–	–
2,209	Deerfield,[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,919	Dennis,	3	1	–	–	5	–	–	–	19	–	–	–	–	–	–	–
2,152	Douglas,	8	–	–	–	13	–	–	–	39	–	–	–	–	–	–	–
798	Dover,	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–
3,461	Dracut,	6	1	–	–	11	5	–	–	19	–	–	–	–	–	–	–
408	Dunstable,	–	1	–	–	1	1	–	–	3	–	–	–	–	–	–	–
1,688	Duxbury,[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
518	Eastham,	1	–	–	–	1	–	–	–	2	–	–	–	–	–	–	–
8,524	Easthampton,[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,191	Edgartown,[3]	1	–	–	–	13	–	–	–	–	–	–	–	–	–	–	–
1,148	Erving,	–	–	–	–	2	–	–	–	6	–	–	–	–	–	–	–
33,484	Everett,	105	7	–	–	288	18	–	–	529	13	56	3	–	–	–	–
5,122	Fairhaven,	19	–	5[4]	–	39	4	–	–	28	–	–	–	–	–	–	–

119,295	Fall River,	673	109	6[4]	–	717	117	–	–	1,040	36	–	–	–	–	–	–		
37,826	Fitchburg,	206	18	9	1	1,577	54	–	–	283	12	13	–	–	–	–	–		
12,948	Framingham,	47	10	–	–	62	8	–	–	146	–	–	–	–	–	–	–		
5,641	Franklin,	6	–	–	–	20	4	–	–	93	5	–	–	–	–	–	–		
1,471	Freetown,	13	1	–	–	5	–	–	–	22	–	–	–	–	–	–	–		
24,398	Gloucester,	65	9	–	–	134	19	–	–	128	1	–	–	–	–	–	–		
152	Gosnold,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
5,926	Great Barrington,	17	2	–	–	3	–	–	–	44	–	–	–	–	–	–	–		
10,427	Greenfield,	37	6	–	–	100	5	6[4]	–	87	2	–	–	–	–	–	–		
452	Greenwich,	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–		
2,155	Groton,	–	–	–	–	6	–	–	–	4	–	–	–	–	–	–	–		
645	Hampden,	1	–	–	–	2	–	–	–	4	–	–	–	–	–	–	–		
2,326	Hanover,	1	–	1[4]	–	–	–	–	–	–	–	–	–	–	–	–	–		
1,854	Hanson,	4	–	–	–	7	1	–	–	22	–	–	–	–	–	–	–		
1,986	Hatfield,	1	–	–	–	12	–	–	–	45	–	–	–	–	–	–	–		
44,115	Haverhill,	262	20	–	–	653	41	–	–	552	22	–	–	–	–	–	–		
1,116	Hinsdale,	–	–	–	–	2	–	–	–	13	1	–	–	–	–	–	–		
2,147	Holden,	30	2	2 2[4]	2[4]	16	3	–	–	12	1	–	–	–	–	–	–		
145	Holland,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–		
57,730	Holyoke,	100	29	–	–	520	63	30[4]	–	612	31	5[4]	–	–	–	–	–		

[1] No record.
[2] No cases traced to milk.
[3] No records until 1913.
[4] Suspected.

Answers to Questionnaire on Milk and Disease, 1909–13 — Continued.

Population, 1910.	City or Town.	Typhoid Fever.				Diphtheria.				Scarlet Fever.				Septic Sore Throat.			
		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.	
				Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.
2,118	Hopedale,[1]	5	1	–	–	7	1	–	–	24	1	–	–	–	–	–	–
1,073	Hubbardston,	3	–	–	–	2	–	–	–	2	–	–	–	–	–	–	–
2,464	Lancaster,	5	–	1[2]	–	23	–	–	–	11	–	–	–	–	–	–	–
947	Lanesborough,	–	–	–	–	–	1	–	–	2	–	–	–	–	–	–	–
85,892	Lawrence,	302	66	–	–	567	86	–	–	493	18	–	–	–	–	–	–
17,580	Leominster,	28	9	1[2]	–	285	18	–	–	126	2	–	–	–	–	–	–
4,918	Lexington,	22	1	–	–	44	2	–	–	71	3	–	–	–	–	–	–
106,294	Lowell,	489	61	54[2]	4[2]	935	119	–	–	1,700	61	–	–	–	–	–	–
1,393	Lunenburg,[3]	2	–	–	–	10	–	–	–	2	1	–	–	–	–	–	–
89,336	Lynn,	317	46	33 9[2]	2 1[2]	1,012	83	–	–	992	23	–	–	–	–	–	–
44,404	Malden,	170	18	–	–	489	44	–	–	740	27	–	–	–	–	–	–
1,460	Marion,	1	–	–	–	10	–	–	–	9	–	–	–	–	–	–	–
270	Mashpee,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23,150	Medford,	56	2	–	–	272	13	–	–	349	7	–	–	–	–	–	–
15,715	Melrose,	51	7	–	–	114	6	–	–	162	2	–	–	–	–	–	–
880	Mendon,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2,202	Merrimac,	5	–	–	–	27	1	–	–	5	–	–	–	–	–	–	–
11,448	Methuen,	25	4	–	–	69	6	–	–	76	2	–	–	13	–	–	–

4,740	Millbury,	4	–	–	–	46	–	–	–	43	–	–	–	–	–	–	–
1,399	Millis,	1	–	–	–	12	3	–	–	16	–	–	–	–	–	–	–
246	Monroe,	1	–	–	–	5	1	–	–	5	–	–	–	–	–	–	–
6,866	Montague,	6	2	–	–	134	7	–	–	22	7	–	–	–	–	–	–
388	Monterey,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
217	Montgomery,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
110	Mount Washington,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2,026	Needham,	5	–	–	–	34	2	–	–	14	–	–	–	–	–	–	–
92	New Ashford,	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–
96,652	New Bedford,	637	86	5 11[2]	2	535	102	–	–	1,148	13	–	–	1	1	–	–
464	New Braintree,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,482	Newbury,	5	–	–	–	5	–	–	–	7	–	–	–	–	–	–	–
14,949	Newburyport,[4]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,124	New Marlborough,	5	–	–	–	1	–	–	–	9	1	–	–	–	–	–	–
639	New Salem,	1	–	–	–	2	–	–	–	2	–	–	–	–	–	–	–
39,806	Newton,	103	12	1[2]	–	248	14	–	–	433	9	16[2]	–	–	–	–	–
22,019	North Adams,	97	22	–	–	109	23	–	–	104	4	–	–	–	–	–	–
19,431	Northampton,	56	4	–	–	119	16	5	–	200	3	–	–	–	–	–	–
5,529	North Andover,	12	2	–	–	24	1	–	–	44	1	–	–	–	–	–	–
1,713	Northborough,	4	–	–	–	16	1	–	–	18	–	–	–	–	–	–	–
8,807	Northbridge,	22	1	–	–	65	6	–	–	74	–	–	–	–	–	–	–

[1] Records incomplete.
[2] Suspected.
[3] No records as to milk supply.
[4] No cases of typhoid reported due to milk.

Answers to Questionnaire on Milk and Disease, 1909–13 — Continued.

Population, 1910.	City or Town.	Typhoid Fever.				Diphtheria.				Scarlet Fever.				Septic Sore Throat.			
		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.	
				Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.
3,075	North Brookfield,	2	1	–	–	2	–	–	–	30	–	–	–	–	–	–	–
1,642	Northfield,	4	1	–	–	5	–	–	–	7	–	–	–	–	–	–	–
1,059	North Reading,[1]	–	1	–	–	–	–	–	–	–	4	–	–	–	–	–	–
1,410	Norwell,	6	–	–	–	7	–	–	–	10	–	–	–	–	–	–	–
552	Oakham,[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,077	Orleans,	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–
3,361	Oxford,	23	1	–	–	10	1	–	–	28	–	–	–	–	–	–	–
8,610	Palmer,	42	2	42	–	–	–	–	–	–	–	–	–	–	–	–	–
416	Paxton,	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–
15,721	Peabody,	44	11	–	–	75	9	–	–	149	3	–	–	–	–	–	–
467	Pelham,	1	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–
2,953	Pepperell,	–	–	–	–	10	2	–	–	19	–	–	–	–	–	–	–
757	Petersham,	1	–	–	–	7	1	–	–	2	–	–	–	–	–	–	–
426	Phillipston,	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
32,121	Pittsfield,[3]	200	33	–	–	361	35	–	–	321	18	–	–	–	–	–	–
406	Plainfield,	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
1,385	Plainville,	3	–	–	–	3	–	–	–	27	–	–	–	–	–	–	–

320	Prescott,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
818	Princeton,	7	1	3[4]	–	2	–	–	–	6	–	–	–	12	–	–	–		
4,369	Provincetown,[5]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
32,642	Quincy,	111	14	14	–	323	21	–	–	353	10	–	–	–	–	–	–		
1,725	Raynham,	2	–	–	–	5	–	–	–	8	2	–	–	–	–	–	–		
5,818	Reading,	3	1	–	–	24	2	–	–	64	2	–	–	–	–	–	–		
18,219	Revere,	48	3	–	–	178	6	–	–	248	4	–	–	–	–	–	–		
1,090	Rochester,	–	–	–	–	5	1	–	–	1	–	–	–	–	–	–	–		
4,211	Rockport,	9	3	–	–	16	1	–	–	67	–	–	–	–	–	–	–		
456	Rowe,	9	2	–	–	–	–	–	–	1	–	–	–	–	–	–	–		
965	Russell,	24	2	–	–	6	–	–	–	10	–	–	–	–	–	–	–		
43,697	Salem,	190	14	–	–	287	33	–	–	374	11	–	–	–	–	–	–		
566	Sandisfield,	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
1,688	Sandwich,	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–		
8,047	Saugus,	65	3	–	–	69	1	–	–	93	1	–	–	–	–	–	–		
2,482	Scituate,	12	1	–	–	6	–	–	–	6	–	–	–	–	–	–	–		
231	Sharon,[6]	1	–	–	–	41	1	–	–	35	–	–	–	–	–	–	–		
1,428	Sherborn,	–	–	–	–	3	–	–	–	7	–	–	–	–	–	–	–		
2,139	Shirley,	5	–	–	–	10	1	–	–	3	–	–	–	–	–	–	–		
267	Shutesbury,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		

[1] No cases reported traced to milk.
[2] No cases due to milk supply.
[3] No cases reported due to milk.
[4] Suspected.
[5] No records of cases traced to milk.
[6] No cases reported due to milk supply.

Answers to Questionnaire on Milk and Disease, 1909–13 — Continued.

Population, 1910.	City or Town.	Typhoid Fever.				Diphtheria.				Scarlet Fever.				Septic Sore Throat.			
		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.	
				Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.
2,798	Somerset,	7	1	–	–	26	3	–	–	25	–	–	–	–	–	–	–
77,236	Somerville,	311	30	13	1	1,070	89	–	–	1,132	24	7	–	–	–	–	–
1,745	Southborough,	3	–	–	–	9	1	–	–	–	–	–	–	–	–	–	–
12,502	Southbridge,	68	8	1[1]	1[1]	80	12	–	–	134	5	–	–	–	–	–	–
4,894	South Hadley,[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
88,926	Springfield,	382	77	6[1]	1[1]	1,118	111	–	–	779	50	–	–	–	–	–	–
1,933	Stockbridge,	–	–	–	–	12	1	–	–	12	–	–	–	–	–	–	–
1,115	Stow,	3	–	–	–	2	3	–	–	–	–	–	–	–	–	–	–
1,047	Sunderland,[2]	1	–	–	–	3	1	–	–	20	11	–	–	–	–	–	–
6,204	Swampscott,	38	2	8 11[1]	1 1[1]	27	2	6 9[1]	1 1[1]	61	1	19 11[1]	1	–	–	–	–
1,978	Swansea,[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
34,259	Taunton,	102	28	–	–	184	24	–	–	305	18	–	–	–	–	–	–
180	Tolland,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
1,174	Topsfield,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,761	Townsend,	6	1	–	–	14	3	–	–	12	–	–	–	–	–	–	–
655	Truro,	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–
829	Tyngsborough,	5	–	–	–	12	–	–	–	15	–	–	–	–	–	–	–

382	Tyringham,	2	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–
2,071	Upton,	3	–	–	–	2	–	–	–	30	–	–	–	–	–	–	–
11,404	Wakefield,	23	7	–	–	64	–	–	–	82	5	–	–	398	–	–	–
4,892	Walpole,	6	1	3[1]	–	41	5	–	–	50	–	–	–	–	–	–	–
27,834	Waltham,	158	12	20 5[1]	6	435	18	–	–	343	7	–	–	–	–	–	–
8,774	Ware,	7	2	–	–	83	7	–	–	21	–	–	–	–	–	–	–
477	Warwick,	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–
12,875	Watertown,	30	4	11	–	103	10	–	–	159	4	–	–	–	–	–	–
11,509	Webster,	7	2	–	–	92	15	–	–	55	3	–	–	–	–	–	–
5,413	Wellesley,	16	1	–	–	53	1	–	–	85	1	–	–	–	–	–	–
1,010	Wenham,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,270	West Boylston,	–	–	–	–	3	–	–	–	13	–	–	–	–	–	–	–
16,044	Westfield,	96	6	9 15[1]	–	206	20	–	–	127	2	18 24[1]	2	–	–	–	–
423	Westhampton,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,353	Westminster,	7	–	2	–	10	–	4[1]	–	18	–	1[1]	–	–	–	–	–
1,473	West Newbury,	3	1	–	–	8	1	–	–	16	–	–	–	–	–	–	–
2,928	Westport,	15	2	–	–	6	2	–	–	25	–	–	–	–	–	–	–
437	West Tisbury,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,266	Westwood,[3]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3,708	Williamstown,	3	–	–	–	50	–	–	–	16	–	–	–	–	–	–	–
1,858	Wilmington,	–	–	–	–	8	1	–	–	17	–	–	–	–	–	–	–

[1] Suspected.

[2] No cases reported due to milk supply.

[3] No record.

Answers to Questionnaire on Milk and Disease, 1909–13 — Concluded.

Population, 1910.	City or Town.	Typhoid Fever.				Diphtheria.				Scarlet Fever.				Septic Sore Throat.			
		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.		Total Cases.	Total Deaths.	Milk.	
				Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.			Cases.	Deaths.
5,678	Winchendon,	11	1	–	–	90	5	–	–	18	–	–	–	–	–	–	–
9,309	Winchester,	15	–	–	–	45	–	–	–	129	1	46	1	–	–	–	–
404	Windsor,	1	1	–	–	5	1	–	–	5	–	–	–	–	–	–	–
10,132	Winthrop,	19	5	–	–	66	6	–	–	113	2	–	–	–	–	–	–
15,308	Woburn,[1]	43	5	–	–	128	10	–	–	132	3	–	–	–	–	–	–
145,986	Worcester,	663	59	198	11	2,056	167	–	–	1,544	47	–	–	–	–	–	–
569	Worthington,[2]	1	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–
1,420	Yarmouth,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
	Grand total,	11,282	1,425	553 135[3]	37 8[3]	31,866	2,580	11 49[3]	1 1[3]	31,012	991	495 57[3]	8	2,436	49	1,914	48

[1] No record of cause of diseases.

[2] No record.

[3] Suspected.

Appendix B.

FORMS OF QUESTIONNAIRE AND LETTERS SENT TO LOCAL BOARDS OF HEALTH, AND A LIST OF CITIES AND TOWNS FAILING TO REPLY TO QUESTIONNAIRE.

Massachusetts State Department of Health,
Boston, July 21, 1915.

To the Local Board of Health.

Gentlemen: — The State Department of Health is making a study of the relation of milk to the transmission of disease.

We are desirous of getting as complete a record as possible of all cases of typhoid fever, diphtheria, scarlet fever and septic sore throat, where milk has been proven to be or has been suspected of being the means of transmission.

We will appreciate it, therefore, if you will fill out the enclosed blank and forward it to us at your earliest convenience, together with any other facts which you feel may have a bearing on this important matter.

By direction of the Commissioner of Health,

Sincerely yours,
Eugene R. Kelley,
Director of Division of Communicable Diseases.

_____1915.

Dr. Allan J. McLaughlin, *Commissioner of Health, State Department of Health, State House, Boston, Mass.*

Dear Sir: — Below you will find a list of the cases of the following diseases occurring in.....during the years 1909–13, classified by this Department with reference to milk supply.

Diseases.	Total Number of Cases, 1909–13.	Cases due to Milk.	Cases, Milk suspected.
Typhoid fever,			
Diphtheria,			
Scarlet fever,			
Septic sore throat,			

Diseases.	Total Number of Deaths, 1909–13.	Deaths due to Milk.	Deaths, Milk suspected.
Typhoid fever,			
Diphtheria,			
Scarlet fever,			
Septic sore throat,			

Yours very truly,

.....
Agent or Secretary of Board of Health.

Massachusetts State Department of Health,
Boston, Sept. 22, 1915.

To the Local Board of Health.

Gentlemen: — Some time ago this Department sent to all local boards of health in the Commonwealth a questionnaire on the relation of milk to certain diseases. In looking over our returns we do not find your reply among them. This is probably an oversight.

We need this information to complete our report on the milk question for the next General Court. The value of these replies will be directly proportional to number of towns reporting. The subject of milk in its relation to disease is so important to every city and town that it ought to amply repay any local board of health for their trouble in looking up their records on the subject.

As you know, the reports of infectious diseases, as they are forwarded to this office, do not indicate the known or suspected source of the infection. Consequently, this Department can only gather such information as is asked for in this questionnaire through the co-operation of the local boards of health. We would, therefore, very greatly appreciate an early return of the enclosed questionnaire, even if your records do not show any cases or deaths due to diseases transmitted by milk.

By direction of the Commissioner of Health,

Sincerely yours,
Eugene R. Kelley,
Director of Division of Communicable Diseases.

Cities and Towns that have not replied to Milk Questionnaire.

Abington.	Bridgewater.	Falmouth.
Acton.	Brimfield.	Florida.
Adams.	Buckland.	Foxborough.
Agawam.	Burlington.	Gardner.
Amherst.	Charlemont.	Gay Head.
Arlington.	Chelmsford.	Georgetown.
Ashfield.	Chilmark.	Gill.
Barre.	Clarksburg.	Goshen.
Bedford.	Concord.	Grafton.
Belchertown.	Conway.	Granby.
Bellingham.	Dalton.	Granville.
Berkley.	Dana.	Groveland.
Berlin.	Dedham.	Hadley.
Bernardston.	Dighton.	Halifax.
Billerica.	Dudley.	Hamilton.
Blandford.	East Bridgewater.	Hancock.
Bolton.	East Longmeadow.	Hardwick.
Boxborough.	Egremont.	Harvard.
Boylston.	Enfield.	Harwich.
Brewster.	Essex.	Hawley.

Cities and Towns that have not replied to Milk Questionnaire — Concluded.

Heath.
Hingham.
Holbrook.
Holliston.
Hopkinton.
Hudson.
Hull.
Huntington.
Ipswich.
Kingston.
Lakeville.
Lee.
Leicester.
Lenox.
Leverett.
Leyden.
Lincoln.
Littleton.
Longmeadow.
Ludlow.
Lynnfield.
Manchester.
Mansfield.
Marblehead.
Marlborough.
Marshfield.
Mattapoisett.
Maynard.
Medfield.
Medway.
Middleborough.
Middlefield.
Middleton.
Milford.
Milton.
Monson.
Monterey.
Nahant.
Nantucket.
Natick.
Norfolk.
North Attleborough.
Norton.
Norwood.
Oak Bluffs.
Orange.
Otis.
Pembroke.
Peru.
Plymouth.
Plympton.
Randolph.
Rehoboth.
Richmond.
Rockland.
Rowley.
Royalston.
Rutland.
Salisbury.
Savoy.
Seekonk.
Sheffield.
Shelburne.
Shrewsbury.
Southampton.
Southwick.
Spencer.
Sterling.
Stoneham.
Stoughton.
Sturbridge.
Sudbury.
Sutton.
Templeton.
Tewksbury.
Tisbury.
Uxbridge.
Wales.
Wareham.
Warren.
Washington.
Wayland.
Wellfleet.
Wendell.
West Bridgewater.
West Brookfield.
West Springfield.
West Stockbridge.
Westborough.
Westford.
Weston.
Weymouth.
Whately.
Whitman.
Wilbraham.
Williamsburg.
Wrentham.

Appendix C.

ABSTRACT OF MILK-BORNE EPIDEMICS IN MASSACHUSETTS FROM 1906–15.

The following is an abstract of epidemics investigated by the State Board and Department of Health of Massachusetts from 1907 to 1915, in which milk was either definitely proven to have been a means of transmission of the infection, or in which the epidemiological evidence of milk as the cause was considered strong enough to classify the outbreak as among the milk-borne outbreaks.

Diphtheria.

Number.	Locality.	Date.	Number of Cases.	Number using Same Milk.	History.	Method of Milk Infection.
1	Milton, Dorchester, Hyde Park, . .	April, 1907, . .	72	69	Outbreak simultaneous in three cities; all but 3 cases supplied by one dealer. Producer's child with the disease; the milk cooler washed by the nurse.	By the nurse of the case washing the milk cooler.
2	North Tewksbury, ...	March, 1908, . .	5	5	"Investigated and thought to be due to milk infection." Report, Massachusetts State Board of Health.	Not stated.
3	Athol, ...	November, 1910, .	16	16	Cases on one route. Milkman found to be sick with the disease himself. First case, milkman.	Either by contact with customers or through infected milk bottles.
4	Northampton, ...	May, 1912, . . .	11	9	Dealer's wife who washed utensils and helped in the milk room had mild case of disease. First case milk dealer's premises.	Woman bottling and washing when an active case.
5	Holbrook, ... / Brockton, ...	September, 1915, .	16 / 11	16 / 11	Outbreak of 30 cases of sore throat in Holbrook, 16 of which were diphtheria; simultaneously, 11 cases of diphtheria in Brockton, all on one route. Five members in producer's family proved carriers. Original case a boy in this family. First case on farm.	Active case and carriers on farm.

Scarlet Fever.

1	Boston, Cambridge, Somerville, Everett, .	January, 1907, . .	717	602	Simultaneous epidemics occurring on route of one large dealer. Epidemic explosive. Milk taster and his family found to have the disease.	By a milk taster.
2	Chicopee, ...	May, 1908, . . .	236	-	236 cases occurred in the city in the year. In investigating found two children of a milkman with the disease. Stopping this supply stopped the steady occurrence of cases.	In part by active cases on farm.

Scarlet Fever — Concluded.

Number.	Locality.	Date.	Number of Cases.	Number using Same Milk.	History.	Method of Milk Infection.
3	Boston and vicinity,	April, 1910,	842	673	A sudden widespread outbreak largely on the route of one large dealer. One case on producing farm found. Milk pasteurized and outbreak stopped.	In part by active case on milk farm.
4	Gardner,	April, 1910,	69	-1	During height of the outbreak, a large percent. of the cases supplied by one dealer who was very faulty in cleansing returned bottles. Cases occurred in his own family, and his business was closed.	Active case in dealer's family.
5	Westfield,	July, 1911,	31	9	Outbreak among Poles who gave it to milkman's family. The father did his own milking. Only part of this outbreak due to milk, the rest were contacts. First case away from farm.	By milkman caring for sick children.
6	West Acton,	April, 1912,	15	11	Sudden outbreak among consumers of one supply. Investigation developed a mild case in the farmer's family. First case on farm.	On the farm from active case.
7	Lowell,	September to December, 1912.	800	400+	Majority of cases occurred on one route. Found that the milk handlers had streptococci throats. Further, found desquamating child on farm of producer whose milk was handled here.	By both milk handlers and active case on farm.
8	Amherst,	January, 1913,	25	25	Sudden outbreak among college students who ate at College Commons. Milk supply ordinarily used ran short, and an unguarded supply was used. Three possible sources found on this extra supply, where cases were unrecognized on producer's farms. First case, college student.	Active cases on farms.
9	Watertown,	October, 1914,	3	3	Wife of milkman had scarlet fever; 2 cases appeared on the route. Supply was cut off. First case on farm.	Active case on farm.
10	Methuen,	December, 1914,	9	9	All on one route. Original case not found. Bottles taken from infected houses and redistributed without sterilization.	Reissuing unsterilized bottles.

1	Cambridge,	April, 1908,	200	200	Outbreak among Harvard students, all eating in Memorial Hall. Examination of milk showed presence of streptococci.	Not proven.
2	Marlborough, Cambridge, Boston, Brookline,	May, 1911,	57 223 800 265	26 218 800 214	Widespread epidemic occurring so largely on route supplied by one large dealer, by milk from one farm, that it was held responsible, although definite origin not proven.	Not proven.
3	Canton,	April, 1913,	–[2]	–[2]	Large outbreak where nearly all cases appeared on route of one milk supply. Found that man who handled bottles and delivered milk had tonsillitis; also 3 in milkman's family, including himself, had tonsillitis. Thirteen deaths. Disease not then reportable.	Milkman, family and bottle handler had the disease.
4	Norton,	June, 1913,	65	65	Students in Wheaton College alone affected; no one outside. All drank milk. Pasteurization stopped the outbreak. First case in college.	Not stated.
5	Westfield,	July, 1914,	129	–[1]	Outbreak largely on one milk route of dealer whose facilities were poor.	Not proven.
6	Winthrop,	July, 1914,	62	–[3]	Dealer and producer combined; 3 of his cows had streptococci in their milk. Premises were unfit for handling milk.	Cow had inflammatory point on udder. Streptococci found in milk. Handler had acute case.
7	Boston, Milton,	September, 1915,	227 84	210 75	All on route of one distributor who did not pasteurize his milk. Four possible sources found on different supply farms.	1. Boy with sore throat then desquamating. 2. Cows with garget. 3. Cows whose milk contained pus. 4. Members of distributor's family with sore throats.

[1] Large per cent. [2] About 400. [3] Most of them.

Number.	Locality.	Date.	Number of Cases.	Number using Same Milk.	History.	Method of Milk Infection.
1	Hanson,	February, 1906,	9	9	Occurred in 5 families who constituted 70 per cent. of the trade of a milk producer and pedler who was himself the second case. Besides handling utensils and doing the milking by this case, the washing water was badly polluted.	By active case on farm or water used for washing pails.
2	Lynn,	August, 1906,	48	31	Explosive epidemic largely on one milk route. Found man employed washing bottles to be an active case. First case, bottle washer on premises of milkman.	Bottle washer an active case.
3	Natick, Needham, Wellesley,	September, 1906,	119	98	Explosive epidemic on route of one dealer in three cities. Found waitress in eating room for dealer's employees was an active case. First case, waitress in dairy.	By waitress directly or indirectly.
4	Cambridge, Somerville,	September, 1907,	61	33	Simultaneous outbreak in two cities, largely on one milk route. Found that a bottler was nursing an active case.	Contact of nurse with milk.
5	Bondsville, Belchertown,	November, 1907,	21	21	Epidemic on one milk route. Found that producer nursed an active case while attending to his dairy work. First case in dairy.	Indirect contact from active case to milk (nurse).
6	Lowell,	August, 1908, to December, 1908.	140	31	Cases occurred on only one of 3 or 4 of this dealer's routes. Bookkeeper moved to hospital with typhoid on September 21, Typhoid bacilli reported in specimen taken from one of his men who was taken from dairy immediately.	Man tasted and mixed all milk. Washed strainer cloths. Delivered milk on route with these cases.
7	Jamaica Plain,	March, 1908,	410	348	Explosive outbreak on two routes where cans of milk were interchanged. Dealer himself died of the disease. Taster had disease. Polluted water used for washing. First case, dealer.	Active case handling milk. Bad water for washing.
8	North Cambridge, Lexington,	July, August, September, 1908.	29 10	–1 –1	Outbreak on the route of one milkman who, while nurse for a case, washed the bottles.	Nurse of case washing bottles.
9	Everett,	May, 1908,	23	12	Outbreak in the family and on the route of one milkman. First case in milkman's family.	Handling by active case.

10	Brockton, ...	May, 1908, . . .	-[1]	-[1]	Series of cases on one route where employee had the disease. First case, milk employee.	Not stated.
11	Maynard, ...	1905 through 1909, .	9	9	Series of cases on one route of man who proved to be a chronic urinary carrier. First case, milkman.	Carrier milking and peddling.
12	Brighton, Waltham, Brookline, . . .	September, 1909, .	113	94	Simultaneous outbreaks in 3 cities on route supplied by one dealer; 3 possibilities found. 1. A milk capper was a probable carrier. 2. The water in the pasture was sewer polluted and may have splashed on the cows. 3. Two boys on one farm had typhoid a year ago — possible carriers.	Not proven.
13	Jefferson, ...	September, 1909, .	60	60	Outbreak widely scattered among guests at hotel, all of whom drank milk which had every opportunity of pollution by waitress who developed the disease first in the series. First case, waitress in hotel.	Serving milk and helping herself out of can or pitcher.
14	Lynn, ...	March, 1910, . .	39	-[1]	Milk supply suspected, was shut off and outbreak stopped.	Not stated.
	Swampscott, ...		9	-[1]		
15	Sterling Junction, ...	September, 1910, .	5	5	Cases in houses supplied by one man who was an active case. First case, producer.	Producer an active case.
16	North Adams, ...	May, 1910, . . .	7	7	Outbreak of 7 cases following a series that had appeared on one man's route for four years. The daughter of the dealer handles the milk and was a carrier. First case, daughter of dealer.	Carrier handling the milk.
17	Ipswich, ...	July, 1910, . . .	42	11	Explosive outbreak on one route where polluted water was used to wash utensils. Rest of cases not due to milk.	Dirty washing water.
18	Wayland, Waltham, Newton, Peabody, Brockton, Milford.	July, 1910, . . .	93	93	All cases on one dealer's route; not explosive; followed having bottles from infected houses.	Bottles from infected houses not sterilized.
19	Lowell, ...	August to November, 1910.	136	58	One of dealer's men had typhoid bacilli in urine. Probably a transient carrier. At one farm supplying dealer proprietor had been sent to the hospital with typhoid, and one of the farm hands had it.	Carrier on farm.
20	Worcester, ...	August, 1910, . .	187	187	Occurred on one dealer's route. Owner had typhoid twenty-six years ago; had been slightly ill two weeks before.	Urinary carrier.

[1] Not stated.

Typhoid Fever — Continued.

Number.	Locality.	Date.	Number of Cases.	Number using Same Milk.	History.	Method of Milk Infection.
21	Swampscott,	August and September, 1910.	7	7	Occurred on one dealer's route on whose premises unsanitary conditions were found. Milk supply was stopped and the outbreak ceased.	Dirty premises.
22	Worcester,	August, 1910,	8	8	Six cases on route and 2 among distributor's helpers developed disease at same time. Found an active case at a supplying dairy.	Active case at dairy.
23	Fitchburg,	June, 1911,	18	12	Occurred on one dealer's route. On one of his supply farms conditions were faulty, and a man there previously had the disease.	Not proven.
24	Maynard,	September, 1910,	4	2	Man, previously proved a carrier and prohibited from selling milk, gave some away and caused 2 cases.	Carrier handling milk.
25	Attleboro,	August and September, 1911.	46	43	Sudden outbreak on one milk route. Found active case on one producer's farm, where also badly polluted water was used for washing pails.	Active case on farm.
26	North Chelmsford,	August, 1912,	6	6	"On investigation it became apparent that it was a milk-borne outbreak. Several Widals were taken on the farm, and a probable carrier was found." (Report of Massachusetts State Board of Health.)	Carrier on farm.
27	Hopkinton,	September, 1912,	8	4	Outbreak among customers of one farm on which was an active case, and where supply was subject to contamination.	Case on farm.
28	Princeton, West Sterling, Chelsea,	January, 1913,	36	35	Series of cases in Princeton and Sterling, and outbreak in Chelsea among users of milk from one farm. Milkman himself had typhoid in 1906, and 3 others in his family since then. Was probably a carrier.	Probable carrier on farm.
29	Cambridge, Somerville, Arlington,	January, 1913,	61	55	Cases all supplied by one dealer who received milk from a farm where a milker was found with a positive Widal.	Carrier on farm.

30	Quincy,	April, 1913,	15	15	All cases occurred on one milk supply. Found active case on out-of-State farm producing milk.	Active case on farm.
31	Pittsfield,	July, 1913,	9	9	Cases on one route. Employee had disease three or four years ago. No Widal secured. Stopped milk and epidemic stopped.	Carrier on farm.
32	Saugus,	July, August and September, 1913.	39	–[1]	All Italians on one supply. Conditions where utensils washed were bad. Probable case in this house two and one-half months previous in person of niece. Stopped milk and cleaned premises and outbreak ceased.	Convalescent case on farm. Dirty condition.
33	Palmer,	August, 1913,	40	40	All cases on one milk supply. Found milker on farm to be an active case.	Active case on farm.
34	Amesbury,	September, 1913,	5	5	Cases all on one route. Wife of milkman the original case.	Active case on farm.
35	Lexington,	November, 1913,	9	9	Cases occurred on one milk route. One of the handlers was found to have a positive Widal, although he gave no typhoid history.	Carrier handling.
36	Boxborough,	September and October, 1912.	3	3	Man drank milk from his own can which was returned to him. This probably infected at milk dealer's in another town. He was the first case.	Not proven.
37	Beverly,	April, 1914,	10	10	Outbreak on one supply getting out-of-State milk. On one of these producing farms was found an active case.	Active case on farm.
38	Watertown,	July, 1914,	27	27	All on one milk route. Premises not sanitary. Milk room inadequate. Positive Widal in milk handler following indefinite sickness.	Active case in milk handler.
39	North Adams,	August, 1914,	39	36	All on route of one distributor who was handling the milk while sick.	Distributor an active case.
40	New Bedford,	September, 1914,	6	6	All on one supply. Employee in sterilizing plant, first case.	Active case in milk room.
41	New Bedford,	September, 1914,	10	10	All on one supply. Milkman himself an active case.	Milkman himself an active case.
42	Weymouth,	October, 1914,	19	19	All on one supply. Conditions at dairy not satisfactory. No other common factor in cases.	Not proven.

[1] Several.

Typhoid Fever — Concluded.

Number.	Locality.	Date.	Number of Cases.	Number using Same Milk.	History.	Method of Milk Infection.
43	Leominster,	October, 1914,	12	12	Explosive outbreak, all having same milk. Convalescent found on farm.	Carrier on farm.
44	Warren,	October, 1914,	4	3	On one milk supply. Producer helped by brother who was active case.	Active case on farm.
45	Auburn,	October, 1914,	3	3	Cases on one milk route. No definite source found, but washing water was polluted.	Not proven. Probably washing water.
46	Roxbury,	January, 1914,	93	93	Explosive outbreak on one unpasteurized supply. Found the owner of one supplying farm was an active case.	Active case on farm.
47	Grafton,	May, 1915,	22	22	Cases in Grafton Insane Colony. All used the milk. All had food from kitchen. Actual point of infection not determined, but were 3 possibilities.	Positive Widals in — 1. Milker on farm. 2. Kitchen helper. 3. Kitchen helper.
48	Newburyport,	July, 1915,	11	7	Majority on one route supplied by man who was sick with probable typhoid. Thorough tests were not permitted.	Producer probably an active case.
49	Mansfield,	August, September, October, 1914; March, April, May, September, October, 1915.	66	–	Dates of occurrence tally with presence on farm of temporary helper who had typhoid forty-five years ago and whose feces showed typhoid bacilli.	Chronic carrier working on farm.
50	Rochdale,	October, 1915,	18	18	Cases occurred under conditions that pointed toward water supply. Proved to be all supplied with milk from farm where the son of the producer, who milked and peddled, had a positive Widal.	Positive Widal in milker.

Recapitulation.

	Number of Cases.	Number of Epidemics.
Diphtheria,	131	5
Scarlet fever,	2,747	10
Septic sore throat,	2,512	7
Typhoid fever,	2,215+	50
	7,605+	72

Appendix

COPY OF LETTER SENT TO, AND REPLIES FROM, EPIDEMIOLOGICAL AUTHORITIES OF OTHER STATES RELATIVE TO MILK AND DISEASE.

The following is a copy of the letter sent to, and replies received from, the epidemiological authorities of New York, New Jersey, Pennsylvania, Maryland, Minnesota and Kansas: —

Boston, Mass., July 30, 1915.

Dear Doctor: — This Department is making a study of the relation of milk to communicable diseases.

We are especially anxious to get all the data possible on cases of typhoid fever, diphtheria, scarlet fever and septic sore throat where milk has been implicated in the transmission of the infection. Are your routine epidemiological reports such that we might get from them an idea of the relative frequency of milk as a means of transmission of these diseases in your State? Would it be asking too much to let us have any reports, analyses or studies along this line that have been made by your department?

While we appreciate the extent of this request, we are impelled to make it only by our willingness to co-operate with you in a like manner at any time.

By direction of the Commissioner of Health,

Sincerely yours,

Eugene R. Kelley,
Director of Division of Communicable Diseases.

Board of Health of the State of New Jersey, Trenton, Aug. 2, 1915.

Eugene R. Kelley, M.D., *Director of Division of Communicable Diseases, State Department of Health, Boston, Mass.*

Dear Doctor: — I am in receipt of your communication of July 30 in which you ask for information in regard to cases of typhoid fever, diphtheria, scarlet fever and septic sore throat traceable to milk infection.

We have no special articles on this subject, but I believe there is on file in your office a complete set of the annual reports of the State Board of Health, and in the reports of the last five or six years you will find reports of interesting epidemics of this nature which have occurred in the State of New Jersey.

With kindest regards, I am

Very truly yours,

A. Clark Hunt, M.D.,
Chief.

Department of Health, City of New York,
Bureau of Preventable Diseases,
139 Centre Street, New York, Dec. 31, 1915.

Dr. Eugene R. Kelley, *Director, Division of Communicable Diseases, Massachusetts State Department of Health, Boston, Mass.*

Dear Doctor: — You, of course, understand the impossibility of judging the number of deaths in endemic typhoid due to milk, for the reason that no one can designate the cases as they appear. All that we can do in this respect is to weigh one set of milk conditions against another and ascribe the difference to one of them. This is what we have done in comparing the number of cases prior to pasteurization of milk with the number after the pasteurization of milk. As the fall was an abrupt one we felt that we were right in our conception as to the relative responsibility of raw milk for the endemic disease, especially as the figures corresponded so closely with those forecast after considering the experience among the patrons of a milk company selling from one to two hundred thousand quarts a day of pasteurized milk as compared with all of the other milk, most of which was unpasteurized. I must admit I have nothing more than just this, and at the same time I can account for the change in no other way.

While we cannot give you the actual number of cases and deaths in the so-called residual milk-borne typhoid, we have them for outbreaks and submit the following: —

1912, ...	184 cases, ...	22 deaths.
1913, ...	561 cases, ...	61 deaths.
1914, ...	No outbreaks.	
1915, ...	119 cases, ...	15 deaths.

This brings to your attention an outbreak in 1915, after pasteurization was generally established. This was a very interesting occurrence. On July 19, 1915, 3 cases of typhoid fever were reported from one comparatively small company, one doing a business of about 10,000 quarts in a limited area, supplying about one-tenth of the population therein. The company had several creameries, but all 3 cases were supplied by one creamery. On the succeeding day 3 other cases were reported. Telephone inquiry developed the fact that various creameries had contributed to their supply, but this particular creamery had participated in each instance. The milk was thereupon excluded from the city.

A careful survey of the conditions at the creamery town showed several cases of typhoid fever in the community, and an examination of the well water used in washing the bottles and machinery showed a high degree of contamination. For the bottles only hot water or steam was used, but on the machinery, especially on the bottler itself, cold water had been used followed by hot steam for sterilization. Under the conditions, the steam penetrated to most parts of the machine, but did not get access to the drop or funnel arrangement by which the milk was directly conveyed to the bottles. As a certain amount of milky

water remained in this situation over night it was surmised that typhoid bacilli may have been present and developed through culture over night, resulting in a high degree of contamination of the freshly pasteurized milk. The well was, of course, at once sealed up before the milk was allowed to re-enter, and there has been no further trouble. No typhoid bacilli, however, were found in the water, though colon bacilli were present in $\frac{1}{100}$ cubic centimeter, as obtained directly at the well. This goes to show the danger subsequent to pasteurization under the present methods.

Of course, pasteurization in bottles would obviate all of this, but the expense of the glassware and the manipulation would be enormous.

Very truly yours,

M. L. Ogan,
Chief, Division of Epidemiology.

New York State Department of Health, Albany, Dec. 9, 1915.

Dr. Eugene R. Kelley, *Director, Division of Communicable Diseases, State Department of Health, Boston, Mass.*

Dear Dr. Kelley: — Your letter of November 27, relative to the number of cases of communicable disease that were transmitted by infected milk in this State, is received. I have delayed replying because I hoped to be able to tabulate the reports of the sanitary supervisors on this subject, but I find that many of them reported the outbreaks with a question mark as to whether or not milk was a means of transmitting the disease. I have, therefore, addressed a special memorandum to them asking them to review their work during the past year, and give me a statement of the number of outbreaks which they have had due to infected milk, stating the number of cases and deaths connected with each outbreak. I think that this report will be much more accurate than one which I could tabulate from the records.

As soon as this report is received I shall be glad to forward a copy to you.

Very truly yours,

F. M. Meader,
Director, Division of Communicable Diseases.

State of Maryland, Department of Health,
16 West Saratoga Street, Baltimore, Sept. 30, 1915.

Dr. Eugene R. Kelley, *Director, Division of Communicable Diseases, State Department of Health, Boston, Mass.*

Dear Doctor: — Several weeks ago you requested data on milk-borne outbreaks of typhoid fever, diphtheria, scarlet fever and septic sore throat in Maryland. A prolonged absence from the city, combined with an unusual press of official work, prevented my sending you this information at an earlier time. If you already have read your paper

on the subject, I trust this material may still be of service to you in your printed article.

We have had no epidemic of diphtheria or of scarlet fever in which the milk supply was implicated, but we have had 7 outbreaks of typhoid fever and 1 of septic sore throat attributed to milk. I shall next give a summary of the typhoid outbreaks, arranged in chronological order.

Milk Outbreaks, Typhoid Fever, in Maryland.

1. The first recorded milk epidemic of typhoid fever in Maryland occurred in Elkton, Cecil County, in July, August and September, 1884. There were 20 cases, but no death. All of the cases but one were supplied with milk from a certain dairy where there was an undoubted case of typhoid fever. The outbreak ended when the use of this dairyman's milk was discontinued.

2. Late in the summer and early in the autumn of 1900 another milk epidemic of typhoid fever occurred in Elkton, Cecil County. This outbreak,[1] traceable to a single dairy, comprised 64 cases, two of which — a white woman aged fifty-six, and a young colored woman — proved fatal. The outbreak began on October 11 and subsided after October 29. Within the first eighteen days, during which time the dairyman's business continued, 39 cases of typhoid fever occurred. He ceased selling milk on October 28. Within three weeks following that date 20 additional cases occurred. Altogether there were 39 infected houses. The dairyman claimed to be regularly supplying 80 houses. On this basis the house incidence was 48.75 per cent. In the 39 infected houses there were 180 people, an attack rate of 33⅓ per cent. The case rate was 1.54 per house. The light fatality, 3.3 per cent., suggests a contagium of slight virulence. The incubation period was variable, ranging from nine to eighteen days. The first 21 cases seemed to indicate periods of incubation averaging under rather than over fourteen days. Three of the patients had suffered previous attacks, one in 1884, one in 1893 and one in 1898.

3. In 1903 an outbreak consisting of 26 cases of typhoid fever, 4 of which terminated fatally, developed among the employees of a shirt factory located in Baltimore City. The firm operating the factory served dairy lunch, the milk of which came from a farm where the water supply was polluted. The epidemic ceased when the milk supply was changed.

4. In May, 1904, there was a milk outbreak of typhoid fever, consisting of 17 cases with 1 death, at Port Deposit, Cecil County. The incubation period, as is usual in milk-borne typhoid fever, was short, all of the cases having been taken ill within a period of ten days. They had a common milk supply, and were users of raw milk. Previous to the outbreak there had been a case of illness on the dairy farm which was diagnosed "grippe."

[1] See an interesting and comprehensive report of this outbreak by Dr. Fulton, in the Journal of Hygiene, London, Vol. I., 1901, pp. 422–429.

5. In October, 1905, there was another milk outbreak of typhoid fever in Port Deposit. This outbreak, explosive in character and limited to the users of one milk supply, comprised 19 cases, 1 of which proved fatal. A case of typhoid was found on the farm supplying the milk. The outbreak ceased when the sale of this milk was stopped.

6. In April, May and June, 1906, there was a remarkable rise in the number of cases of typhoid fever in the Woodberry-Hampden district of Baltimore City. This outbreak, which occurred on one milk route, led to the discovery that one of the farms supplying this milk had cases of the disease among the employees, one of them being a milker. Stopping the sale of this milk put an end to the epidemic, which totaled 157 cases.

7. In May and June of the present year (1915) there was an outbreak of typhoid fever at the Maryland Tuberculosis Sanatorium, which attacked the several groups of patients and employees using milk from one of the 7 dairymen supplying the institution. Upon investigation it was found that an unrecognized case of typhoid fever had occurred in April, in the wife of the dairyman furnishing the infected milk. The outbreak subsided when the sale of milk from this dairy was stopped. The outbreak consisted of 27 cases, 19 of them tuberculous patients and 8 healthy persons. Three deaths occurred in the former group, and none in the latter.

Septic Sore Throat.

So far we have had but one explosive outbreak of septic sore throat in Maryland, spread through the agency of milk. This occurred in Baltimore City and its immediate vicinity, in February and March, 1912. The extent of this epidemic, apparently a streptococcus infection, can only be surmised. It may be estimated that certainly not less than 1,000 and perhaps as many as 3,000 cases occurred, causing 30 or more deaths. Over 85 per cent. of the cases were in families obtaining their milk supply wholly or in part from a single dairy.

Very truly yours,

C. W. G. Rohrer,

Acting Chief, Bureau of Communicable Diseases.

P.S. — Under another cover I am sending you three reprints on the septic sore throat epidemic, described in the paragraph immediately preceding. Two are by Dr. Hamburger and the third by Dr. Frost.

I presume you already possess a copy of Hygienic Laboratory Bulletin No. 41, entitled "Milk and its Relation to the Public Health," published in 1908. It is replete with information bearing upon the relation of milk to the spread of communicable diseases, etc. — C. W. G. R.

[Extract.]

Nov. 27, 1915.

Dr. C. Hampson Jones, *Chief of Bureau of Communicable Diseases, Department of Health, Baltimore, Md.*

Dear Dr. Jones: —

. . . . . .

We were much interested in receiving a communication from Dr. Rohrer, giving the frequency of milk-borne epidemics of typhoid fever, scarlet fever and diphtheria according to his records. The question has come up as to whether or not these figures include Baltimore. Will you kindly let me know?

Sincerely yours,

Eugene R. Kelley,
Director of Division of Communicable Diseases.

State of Maryland, Department of Health,
15 West Saratoga Street, Baltimore, Nov. 29, 1915.

Dr. Eugene R. Kelley, *Director, Division of Communicable Diseases, State Department of Health, Boston, Mass.*

Dear Doctor: — In looking over Dr. Rohrer's letter to you I find that his report includes those outbreaks of disease that occurred not only in the State, but in Baltimore City.

I found, however, that one similar outbreak in Baltimore City has been omitted which occurred while I was there, and a report of it was made at the time of its occurrence, but I regret to say that I cannot now give a reference to the same nor the exact date of outbreak. It is my impression that it was somewhere between 1908 and 1910, and that it occurred in summer time, and the cases were detected by the system we had in the Health Department of daily scanning the report cards of the health wardens by an officer of the Food and Dairy Division, the health warden's cards showing what milk was consumed by the family of the sick one.

A dairy located in the tenth ward suddenly looming up with a number of cases caused a review to be made of the producing dairies which were sending milk to it, which in this case fortunately happened to be but few, — not more than four, — so we quickly examined the condition of the farms of each producing dairy and found a typhoid fever case in a Harford County dairy that was sending the milk to the distributing dairy in Baltimore City. The closing of the producing dairy until all danger had passed effectually and quickly stopped the distribution of the disease. My recollection is that there developed between 55 and 60 cases of typhoid fever on this man's milk route.

Yours respectfully,

C. Hampson Jones,
Chief, Bureau of Communicable Diseases.

MINNESOTA STATE BOARD OF HEALTH,
DIVISION OF PREVENTABLE DISEASES,
UNIVERSITY CAMPUS, MINNEAPOLIS, MINN., Aug. 3, 1915.

Dr. EUGENE R. KELLEY, *Director, Division of Communicable Diseases, Massachusetts State Board of Health, Boston, Mass.*

DEAR Dr. KELLEY: — We will be glad to co-operate with you in every possible way in your study of the relation of milk to typhoid, diphtheria, scarlet fever and septic sore throat.

We have had no outbreak of septic sore throat reported in Minnesota. We have a considerable number of records showing the influence of milk in the spread of other diseases. I will collect this information for you as soon as time permits and forward it.

With kindest regards, I am,

Respectfully,

A. J. CHESLEY,
Director.

MINNESOTA STATE BOARD OF HEALTH,
DIVISION OF PREVENTABLE DISEASES,
MINNEAPOLIS, MINN., Aug. 23, 1915.

Dr. EUGENE R. KELLEY, *Director, Division of Communicable Diseases, State Board of Health, State House, Boston, Mass.*

DEAR Dr. KELLEY: — In endeavoring to comply with your request, regarding instances in which milk has been implicated in the transmission of scarlet fever, diphtheria and typhoid fever, I am somewhat disappointed.

Dr. Greene was kind enough to go through the records of the Division very carefully from Aug. 1, 1909, to date. He made a card index of reports where it seemed that milk might have been a factor in the spread of infection.

I have gone through all these reports. While many of them indicate that milk was a factor to some extent in the spread of disease, only in a few was milk the chief route of infection or definitely proven to be an active factor. As you know, many times we have been called only when the epidemic was at its height, sometimes even on the wane, and the data which are collected under such conditions are not conclusive, although they are very suggestive.

Certain of the instances are given in the enclosed summaries. Others are to be found in the published reports.

To begin with, I may mention one due to butter, not milk. The summaries for this will be found under the heading, Anoka Typhoid, May 29 to 30 and June 5 to 6, 1912, page 240, Report of the Division of Epidemiology, August, 1910, to August, 1912.

Some explanation is necessary in addition to the information given in the Summaries. Dr. Hill made a very careful epidemiological study,

but was obliged to leave Anoka before he had finished, and sent me to finish the work. He left his epidemiological notes (mostly illegible), and told me how he had sized up the situation. Acting upon his theory of causation, I used such data as I could unravel from his notes, then attempted to solve the problem upon a certain hypothesis. I never did such a thing before, and have never attempted it since. Of course the hypothetical solution was to be checked up by actual investigation.

Assuming that butter was responsible for the spread of typhoid infection, Dr. Hill had record of the number of persons in each family who used the suspected butter. A grocer simply acted as a distributor to regular customers. The packages were never opened between the dairy and the customer. There was record of every package delivered. Dr. Hill had noted whether the families had butter left from previous deliveries or not.

I weighed a piece of butter about the size of a chunk ordinarily consumed by one individual at a meal, and figured how many pieces of this size there would be in each jar delivered. On figuring out the time the butter would last, it appeared that it had all been consumed four days before Dr. Hill was notified that the epidemic was in progress, and therefore all the precautions taken were of no avail. It appeared that other cases would come down, up to a certain time.

For instance, in packing the butter into the jars, the upper part of the first crock would be contiguous to the bottom of the second jar; and if we assume that infection from the fingers occurred at this time, then the family using butter from the first jar should fall ill earlier than the family using butter from the second jar, because they would not get any infected material until the bottom of the jar was reached. In other families who had some butter from previous deliveries on hand, the infection would not be incurred at the time it would in the first family mentioned.

The only persons who had typhoid who were not in the families of regular customers for this butter attended a church social where a woman who supplied butter had the jar from the dairy delivered at the time it was assumed the batch had been infected. It was one of those socials where certain items are supplied by certain women, and this lady supplied the infected butter, it seems.

I went directly to the farm and found, upon questioning the people, that a girl visiting in the family had packed the particular batch of butter under suspicion. The farmer's wife made the butter, as usual, but on the morning it should have been delivered she was sick and asked the girl to pack the butter into the jars. This girl had been feeling unwell for some time, and had consulted a woman physician, who afterwards admitted that the girl undoubtedly had walking typhoid, although she did not report the case to the local health officer or send blood for Widal test. The symptoms the girl gave were suspicious. A blood test showed Widal reaction present. Attempts were made to isolate typhoid bacilli

from her discharges, and finally an organism was obtained which was typical for typhoid, except in one of the sugar media. It agglutinated with her blood.

We did not tell the grocer or the customers that we had found the epidemic to be due to the use of infected butter. The farmer's wife had already made two or three batches of butter, and it had been used, and we let them go on just as usual. The butter found to be infected was the only batch which had been packed by any one except the farmer's wife.

There is another instance given where cheese, as well as milk, had something to do with the spread of typhoid infection. (See Summaries 271 and 279, XIV.; also the extract from the health officer's report written on the back of the Confidential Data for 279.)

We had a lot of trouble about this case, for the people sold their farm and moved into town, and later threatened to sue the health officer and the State Board of Health for ruining their business.

In Summaries 60 and 73, XIII., there is another instance of typhoid being spread by milk.

Summary 132, XIII., is given to supplement the report on page 73 of the Division of Epidemiology report, Aug. 1, 1912, to Dec. 31, 1913. While we did not personally collect the epidemiological data for the St. Paul cases, we checked over every point with the St. Paul Health Department, and I am sure that this showed a clear-cut milk-borne infection, although we did not prove by laboratory tests that the suspected carrier had typhoid bacilli in his discharges.

In Summary 169, XIV., the solution is given for cases of typhoid in Stillwater which had not been traced previously. I made an investigation there in 1912, and was unable to find the source of infection. It is true that there were but few cases, and they were scattered over a considerable period of time, making it impossible to get reliable information as to milk, etc., common to the different cases. Dr. Greene worked it out in 1914, and later Dr. F. L. Landeen gave us further information, as follows: —

"I have a list of 16 typhoid cases, half of which I attended professionally. Twice, at least, cases have come in waves, those occurring eight years ago and this year (1914). Some cases were light, some ordinary and some fatal. I have no way of getting records further back than seventeen years ago, when the first case in my list occurred."

Dr. Landeen stated that all of these cases were traceable to the carrier discovered by Dr. Greene. This woman had supplied milk to neighbors for many years.

The final milk-borne typhoid report is that for the School for Feeble Minded at Faribault. You will find that Summaries 88 and 95, XIV., will give you a better idea of the conditions at the school than if you had only the three which relate specifically to the milk-borne infection, namely, 187, 197 and 232, XIV. There was further comment in the

State of Kansas,
Department of the State Board of Health,
Topeka, Kan., Aug. 6, 1915.

Dr. E. R. Kelley, *Director, Division of Communicable Diseases, Boston, Mass.*

Dear Doctor: — Replying to yours of July 29, will say that it has been impossible for this department to publish in a routine way all the epidemiological investigations. As you know, our bulletin is always crowded, and the State printer does not see fit to loosen up with any more paper.

However, replying to your inquiry directly, will say that we have had only two epidemics traceable directly to milk in the past two years. One was the epidemic of typhoid at Parsons and another at Wichita. The Wichita report has not been published, but we are sending you herewith the Parsons report. The department has knowledge of other epidemics which have been attributed to milk, but there are no definite epidemiological records. We shall be very glad, however, to send you future reports along this line from time to time.

With kindest regards, I am,

Fraternally yours,

John J. Sippy, M.D.,
Epidemiologist.

paper by Miss Wade and Dr. McDaniel on this epidemic. See enclosed reprint, "Observations on the Widal Reaction following the Administration of Typhoid Vaccine."

The Faribault school is Institution B. It is a curious thing that the only cases of typhoid that have appeared in this school since the epidemic reported have been among persons who did not show Widal reaction present, although they were said to have been properly vaccinated.

There is another reference to this epidemic in an article by Dr. McDaniel and Miss Wade in the August "Journal of the American Public Health Association." I will send you later a reprint of an article by Dr. Hill, relating to the spread of typhoid through milk in North Branch, Minn. This occurred several years ago, when I was bacteriologist, and I had to send away to get reprints, but will have them for you soon.

In regard to milk in diphtheria, see page 313 of the Laboratory Division Report, 1911 to 1913. In addition, for a butter-borne diphtheria infection, see page 203 of the Division of Epidemiology report, Aug. 1, 1910, to Aug. 1, 1912.

In regard to the length of time that diphtheria bacilli survive in butter, Dr. L. P. Pearsall conducted experiments several years ago which showed that virulent diphtheria bacilli could be recovered from butter kept under various conditions for two to three months. Some of the butter from which the bacilli were recovered was so long kept that it was unfit for human consumption.

Regarding milk in scarlet fever, we have records of three epidemics where it is probable that milk played a part in the spread of scarlet fever. However, I have not given these, since the evidence was not conclusive. The epidemic outlined in Summary 76, XIV., was very clear cut. It was milk borne without question.

In regard to septic sore throat, no epidemic has occurred, to our knowledge, in Minnesota. I may say that in several epidemics which I personally investigated there was strong circumstantial evidence indicating that milk was the main route of infection. However, careful investigation proved that appearances were deceptive, for it was readily shown that the milk could not have been infected, and the cases suspected to be milk infections were traced to direct contact with known cases at a time which would account for the infection.

I am sorry that we have no more definite material for you, but I have asked Dr. I. J. Murphy, now executive secretary of the Minnesota Public Health Association, but for many years epidemiologist for the Duluth city Board of Health, to look up certain milk-borne infections which he investigated in Duluth. He promised to do this. When I receive his notes I will forward the information.

A. J. Chesley,
Director.

Appendix E.

INFLUENCE OF PASTEURIZATION ON CHEMICAL CONTENT OF MILK.

BY HERMANN C. LYTHGOE, CHARLES H. HICKEY AND CLARENCE E. MARSH.

This work was undertaken by reason of the testimony of certain commercial chemists in a contested case, to the effect that the pasteurization of milk would tend to lower the refractive index of the milk serum by causing a hydrolysis of the milk sugar and thereby reducing the concentration of the serum to such an extent that a sample of normal market milk free from added water would be almost certain to be considered adulterated when tested by means of the usual methods devised for that purpose. These chemists never published this statement, probably owing to the fact that careful experiments would show its absolute fallacy.

After the work was completed it was found that in addition to solving the problem investigated we had obtained valuable data for other considerations.

In order to show whether or not the influence of heat upon lactose solutions caused a reduction in its refractive index, an aqueous solution of lactose was divided into two parts, to one of which some citric acid was added. Each of these solutions was divided into three parts, one of which was connected with a return-flow condenser and heated in a boiling water bath for ten minutes. Another was heated in a similar manner for forty-five minutes, and the third portion was kept at the room temperature. It would appear that if any great change in concentration due to hydrolysis occurred by heating lactose solutions it would be shown by these experiments. The results are shown in Table I.

TABLE I. — *Influence of Heat on Lactose Solutions.*

	Temperature (Degrees C.).	Refractive Index.	Polarization 200 millimeters, Ventake Scale.
Lactose solution: —			
Not heated, ...	22.5	43.6	25.16
Heated ten minutes, ...	22.5	43.8	24.50
Heated forty-five minutes, ...	22.5	43.8	24.30
Lactose citric acid solution: —			
Not heated, ...	22.5	46.3	24.56
Heated ten minutes, ...	22.5	46.4	24.50
Heated forty-five minutes, ...	22.5	46.6	24.54

These figures show that the boiling of lactose solutions with or without the addition of citric acid has practically no influence upon the refractive index.

In order to determine the effect of pasteurization upon milk and cream, 20 samples of milk of known purity and 2 samples of certified milk were obtained. In collecting the samples of known purity milk, the dairies in each instance were visited by one or more of us, the cows milked in our presence, and a 6-quart sample of the thoroughly mixed milk taken from the mixing tank. In two instances, owing to the fact that the mixing tank was small and bottling was begun before all the cows were milked, 6 1-quart samples were taken intermittently during the bottling in such a manner that the mixture of these samples gave a fairly accurate indication of the herd milk. The samples were all milked in the evening. The next day the sample was thoroughly mixed and two one-half pint portions removed; the balance, after warming to blood heat, was passed through the separator. The cream was divided into parts and two one-half pint samples of the skimmed milk were taken. One sample each of the whole milk, skimmed milk and cream were then pasteurized by placing the bottles in warm water, stirring with a thermometer until the desired temperature was attained. The bottles were then stoppered and placed in a thermostat heated to the temperature of pasteurization, where they were kept for thirty minutes or more. In some instances samples were withdrawn during the holding process. After the holding period had elapsed the samples were cooled. In four instances the whole

milk was not pasteurized. The raw and pasteurized samples were then submitted to analysis, determinations being made in most instances of solids, fat, total proteins, ash, lactose, copper serum refraction, sour serum refraction and sour serum ash. After the refractive index had been determined the serum was placed in a test tube, heated in boiling water for five minutes, cooled, filtered and the refractive index of the clear filtrate determined. Owing to the limited quantity of sample, particularly of cream, the work could not be done in duplicate; therefore the majority of the figures reported are the result of single determinations. Sample X was treated in a somewhat different manner. A one-half pint sample of the whole milk was removed, and $2\frac{1}{2}$ quarts were passed through the separator in order to obtain the raw milk, skimmed milk and cream. The remaining 3 quarts were pasteurized, and while still hot $2\frac{1}{2}$ quarts were passed through the separator in order to obtain the samples of pasteurized milk, skimmed milk and cream. The resulting cream, therefore, contained a different fat content than that obtained from the raw milk, and no attempt was made to adjust the raw cream by adding skimmed milk. The results of the analyses are given in Table II.

TABLE II. — *Analyses of Samples of Milk, Skimmed Milk and Cream of Known Purity.*

		Temperature.		Time (Minutes.)	Milk.							
		Degrees C.	Degrees F.		Solids.	Fat.	Protein.	Ash.	Lactose.	Copper (Refraction).	Sour Serum (Refraction).	Sour Serum (Ash).
XIII.,	Raw,	–	–	–	14.18	4.70	3.46	0.73	5.03	38.5	42.8	0.790
	Pasteurized,	75	167	30	14.12	4.80	3.43	0.70	5.00	37.2	41.7	0.780
XI.,	Raw,	–	–	–	12.80	3.85	3.35	0.74	4.85	38.2	42.2	0.788
	Pasteurized,	74	165	30	13.18	4.00	3.31	0.74	4.82	37.0	40.2	0.788
XII.,	Raw,	–	–	–	12.28	3.50	3.27	0.74	4.72	37.3	40.8	0.776
	Pasteurized,	75	167	30	12.30	3.60	3.26	0.74	4.70	36.3	38.6	0.796
XIX.,	Raw,	–	–	–	12.72	3.90	3.12	0.76	5.07	38.8	43.0	0.792
	Pasteurized,	74	165	30	12.90	3.80	3.27	0.74	5.13	37.3	40.8	0.808
XVI.,	Raw,	–	–	–	12.76	4.00	2.98	0.76	4.60	37.7	40.8	0.768
	Pasteurized,	74	165	30	13.08	4.10	2.98	0.72	4.64	36.7	40.0	0.784
XVIII.,	Raw,	–	–	–	12.19	3.65	2.98	0.70	4.63	37.7	41.3	0.762
	Pasteurized,	74	165	30	12.50	3.65	2.96	0.74	4.65	37.0	40.4	0.758
XXI.,	Raw,	–	–	–	12.00	3.90	3.11	0.75	4.42	36.7	40.0	0.788
	Pasteurized,	70	158	30	12.08	3.90	3.08	0.66	4.34	36.0	38.7	0.788
VIII.,	Raw,	–	–	–	12.30	3.80	3.01	0.72	4.96	37.6	41.0	0.764
	Pasteurized,	70	158	30	12.34	4.00	2.97	0.72	4.89	37.2	40.2	0.772
VII.,	Raw,	–	–	–	12.85	4.10	3.17	0.66	5.04	38.6	42.0	0.772
	Pasteurized,	73	163	30	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]
XXII.,	Raw,	–	–	–	11.74	3.40	3.06	0.72	4.50	37.0	39.6	0.780
	Pasteurized,	70	158	30	12.08	3.50	3.03	0.72	4.50	36.7	38.9	0.812

XX.,	Raw,	–	–	–	11.28	3.20	2.83	0.74	4.35	37.1	39.5	0.752
	Pasteurized,	70	158	30	11.30	3.25	2.85	0.66	4.31	36.4	38.3	0.748
IV.,	Raw,	–	–	–	13.10	4.20	3.02	0.75	5.12	38.8	42.7	0.812
	Pasteurized,	70	158	30	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]
XVII.,	Raw,	–	–	–	12.97	4.40	3.07	0.76	4.80	38.0	42.3	0.760
	Pasteurized,	70	158	30	13.00	4.40	3.04	0.77	4.89	37.3	41.4	0.777
XIV.,	Raw,	–	–	–	12.14	3.40	3.15	0.75	4.70	37.8	41.7	0.796
	Pasteurized,	75	167	30	12.18	3.40	3.15	0.74	4.71	36.3	39.0	0.788
V.,	Raw,	–	–	–	12.10	3.70	3.03	0.74	4.57	37.5	40.7	0.820
	Pasteurized,	73	163	30	12.26	3.70	3.01	0.68	4.57	36.6	39.7	0.816
IX.,	Raw,	–	–	–	–	–	–	–	–	37.5	41.4	0.776
	Pasteurized,	70	158	30	–	–	–	–	–	37.3	–	–
XV.,	Raw,	–	–	–	12.44	3.70	3.13	0.66	4.92	38.0	42.0	0.750
	Pasteurized,	75	167	30	12.44	3.70	2.98	0.70	4.93	37.1	40.0	0.762
X.,	Raw,	–	–	–	12.84	4.00	3.21	0.76	4.92	38.0	40.8	0.766
	Pasteurized,	75	167	30	13.16	4.00	3.20	0.74	5.00	36.8	39.9	0.782
I.,	Raw,	–	–	–	12.58	3.60	3.38	0.74	4.64	38.0	42.0	0.812
	Pasteurized,	80	176	30	12.92	3.70	3.44	0.74	4.71	36.4	40.3	0.812
II.,	Raw,	–	–	–	13.08	4.05	3.20	0.70	4.85	38.2	42.1	0.742
	Pasteurized,	80	176	30	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]
VI.,	Raw,	–	–	–	13.48	4.70	3.25	0.78	5.16	38.6	42.2	0.802
	Pasteurized,	65.6	150	40	13.96	4.65	3.21	0.80	5.13	38.4	41.7	0.821
III.,	Raw,	–	–	–	12.45	3.60	3.21	0.74	4.97	38.3	43.0	0.801
	Pasteurized,	75	167	30	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]	–[1]

[1] Not pasteurized.

TABLE II. — *Analyses of Samples of Milk, Skimmed Milk and Cream of Known Purity* — Continued.

		Skimmed Milk.								Cream.						
		Solids.	Fat.	Protein.	Ash.	Lactose.	Copper (Refraction).	Sour Serum (Refraction).	Sour Serum (Ash).	Fat.	Protein.	Ash.	Lactose.	Copper (Refraction).	Sour Serum (Refraction).	Sour Serum (Ash).
XIII.,	Raw, . .	10.16	0.40	3.66	0.78	5.18	38.5	42.8	0.780	52.0	1.63	0.39	2.78	38.6	–	–
	Pasteurized, .	10.12	0.60	3.58	0.76	5.17	36.8	–	–	52.0	1.61	0.39	2.75	37.2	–	–
XI.,	Raw, . .	9.44	0.05	3.40	0.76	4.86	38.3	42.2	0.780	45.8	1.77	0.40	2.91	38.5	43.5	0.800
	Pasteurized, .	9.56	0.05	3.43	0.76	4.90	37.2	40.5	0.792	45.8	1.77	0.40	2.86	37.0	39.8	0.792
XII.,	Raw, . .	9.20	0.20	3.40	0.74	4.81	37.3	40.8	0.776	44.0	1.79	0.36	2.80	37.7	–	–
	Pasteurized, .	9.10	0.25	3.36	0.74	4.79	36.3	41.9	0.792	44.7	1.79	0.38	2.82	36.7	–	–
XIX.,	Raw, . .	9.52	0.20	3.21	0.76	5.01	38.9	43.8	0.800	42.5	1.93	0.42	2.80	38.9	45.4	0.800
	Pasteurized, .	9.52	0.10	3.27	0.76	5.08	37.0	41.1	0.810	42.5	1.93	0.42	3.10	37.4	41.4	0.760
XVI.,	Raw, . .	9.18	0.05	3.12	0.74	4.72	37.7	41.6	0.780	42.0	1.85	0.50	2.98	37.5	43.7	0.796
	Pasteurized, .	9.30	0.05	3.05	0.74	4.82	36.9	40.3	0.776	41.6	1.92	0.46	2.96	36.7	41.7	0.824
XVIII.,	Raw, . .	8.90	0.10	3.06	0.74	4.60	37.9	41.6	0.764	40.0	2.02	0.44	3.12	38.0	41.9	0.744
	Pasteurized, .	9.10	0.10	3.12	0.70	4.71	37.0	40.8	0.760	39.5	2.08	0.50	2.86	37.0	40.0	0.738
XXI.,	Raw, . .	8.72	0.20	3.11	0.74	4.40	36.9	40.0	0.760	36.0	1.98	0.36	3.00	37.0	40.0	0.758
	Pasteurized, .	8.82	0.20	3.18	0.74	4.48	36.0	40.7	0.769	36.0	2.03	0.46	2.96	36.3	38.0	0.748
VIII.,	Raw, . .	8.90	0.05	3.05	0.74	4.90	37.6	41.3	0.756	35.5	2.09	0.48	2.62	38.0	41.2	0.748
	Pasteurized, .	9.12	0.10	3.13	0.76	4.95	37.3	40.3	0.764	35.0	2.02	0.52	2.75	37.4	40.2	0.756
VII.,	Raw, . .	9.56	0.50	3.20	0.66	5.02	38.6	41.7	0.752	35.2	2.12	0.47	2.72	38.7	42.1	0.776
	Pasteurized, .	9.82	0.60	3.37	0.63	5.12	37.6	40.5	0.764	35.4	2.16	0.52	2.69	37.8	40.7	0.776
XXII.,	Raw, . .	8.80	0.35	3.12	0.72	4.60	37.0	39.9	0.820	35.2	2.11	0.47	3.50	37.5	41.0	0.748
	Pasteurized, .	9.00	0.30	3.08	0.72	4.60	36.7	40.1	0.800	35.2	2.11	0.49	3.50	36.1	38.9	0.765

XX.,	Raw,	8.52	0.20	2.92	0.74	4.58	37.0	40.5	0.744	34.5	1.93	0.44	3.14	37.4	41.9	0.738
	Pasteurized,	8.52	0.20	2.89	0.72	4.58	36.3	38.7	–	34.5	1.93	0.46	3.19	36.3	38.8	0.748
IV.,	Raw,	9.84	0.55	3.33	0.83	5.18	38.9	43.4	0.808	30.3	2.39	0.53	3.61	38.8	42.7	–
	Pasteurized,	10.14	0.65	3.31	0.78	5.22	38.5	42.2	0.816	30.0	2.25	0.54	3.71	38.5	41.7	0.828
XVII.,	Raw,	9.15	0.50	3.15	0.79	5.00	38.0	40.6	0.767	28.7	2.20	0.51	3.60	38.0	43.0	0.771
	Pasteurized,	9.20	0.50	3.17	0.80	4.99	37.4	41.5	0.764	28.7	2.22	0.55	3.66	37.3	42.7	0.774
XIV.,	Raw,	9.20	0.05	3.19	0.79	4.77	37.8	41.5	0.800	28.4	2.43	0.54	3.74	37.9	42.7	0.804
	Pasteurized,	9.32	0.05	3.23	0.79	4.79	36.4	39.2	0.768	28.5	2.43	0.58	3.72	36.9	40.2	0.804
V.,	Raw,	9.14	0.60	3.03	0.80	4.72	37.4	41.4	0.820	27.0	2.23	0.48	3.75	37.4	41.4	0.832
	Pasteurized,	9.20	0.50	3.09	0.68	4.71	36.5	39.7	0.820	27.2	2.25	0.52	3.74	36.8	39.8	0.811
IX.,	Raw,	–	–	–	–	–	37.5	41.0	0.780	–	–	–	–	38.3	42.3	0.771
	Pasteurized,	–	–	–	–	–	37.2	40.4	0.780	–	–	–	–	38.3	42.4	0.784
XV.,	Raw,	9.33	0.50	3.08	0.70	4.91	38.1	–	–	26.0	2.39	0.54	3.76	38.0	–	–
	Pasteurized,	9.06	0.10	3.01	0.70	5.06	37.0	–	–	26.0	2.42	0.54	3.78	37.0	–	–
X.,	Raw,	9.56	0.40	3.36	0.80	5.11	38.0	40.9	0.786	25.2	2.40	0.63	3.14	38.0	40.9	0.786
	Pasteurized,	9.66	0.20	3.27	0.83	5.05	36.9	40.0	0.782	15.0	2.93	0.75	3.46	37.4	40.7	0.810
I.,	Raw,	9.28	0.20	3.48	0.77	4.72	37.9	42.0	0.816	–	2.49	0.56	3.98	38.0	41.9	0.824
	Pasteurized,	9.68	0.20	3.54	0.81	4.81	36.7	40.5	0.784	–	2.87	0.62	3.96	37.3	42.1	0.840
II.,	Raw,	9.44	0.30	3.37	0.70	4.98	38.2	42.2	0.740	21.5	2.62	0.57	4.16	38.3	42.3	0.749
	Pasteurized,	9.60	0.30	3.34	0.70	5.00	36.5	39.8	0.756	21.5	2.67	0.60	4.15	36.5	39.6	–
VI.,	Raw,	11.30	2.20	3.33	0.74	5.15	38.6	43.0	0.810	21.0	2.55	0.64	4.44	38.6	43.5	0.792
	Pasteurized,	11.37	2.20	3.32	0.78	5.14	38.4	42.2	0.821	21.0	2.55	0.68	4.46	38.4	44.2	0.792
III.,	Raw,	9.60	0.40	3.26	0.78	5.03	38.4	45.7	0.794	16.2	2.97	0.63	4.14	38.3	43.5	0.806
	Pasteurized,	9.58	0.40	3.22	0.75	5.05	37.0	43.5	0.826	16.4	2.80	0.62	4.20	37.0	40.2	0.794

It will be seen from a perusal of these tables that heating has but little effect upon the percentage of the milk constituents estimated other than that caused by a slight concentration. In the case of the serum, however, there was a diminution of the refractive index due to more or less coagulation of the albumin. The maximum and average differences between the milk constituents are shown in the following table.

TABLE III. — *Difference between Raw and Pasteurized Samples.*

Milk.

	Maximum Difference.		Average pasteurized.
	Pasteurized above —	Pasteurized below —	
Solids,	0.48	0.06	0.17 higher
Fat,	0.20	0.10	0.04 higher
Proteins,	0.05	0.15	0.01 lower
Ash,	0.08	0.09	0.003 lower
Lactose,	0.70	0.10	0.005 higher

Skimmed Milk.

Solids,	0.40	0.27	0.095 higher
Fat,	–	–	–
Proteins,	0.17	0.09	0.003 higher
Ash,	0.04	0.12	0.008 lower
Lactose,	0.15	0.06	0.036 higher

Cream.

Fat,	0.70	0.70	0.045 lower
Proteins,	0.38	0.14	0.022 higher
Ash,	0.06	0.04	0.022 higher
Lactose,	0.30	0.28	0.018 higher

COMPARISON OF SERUM OF MILK, SKIMMED MILK AND CREAM.

The serum of skimmed milk and of cream is the same as that of the whole milk from which it was obtained, although our figures in a few instances do not seem to bear out this statement. The variations in the refractive index of the sour serum are due, no doubt, to changes in the character and the duration of the

fermentation. If the same sample of milk is divided into several portions and fermented with different ferments, the refractive indices of the serums will be different. The variation in the refractive indices of the copper serums made from milk, skimmed milk and cream from the same source can be explained, as follows: It is a well-known fact that if a sample of milk is allowed to set, the bacterial content of the cream is greater than that of the skimmed milk. These samples in which the serum refraction of the cream was greater than that of the milk were obtained under such circumstances that they could not be cooled at the time of milking, and were not transferred to the laboratory ice chest for some hours. The following morning it was noticed that the cream was slightly sour, although the balance of the milk was normal. The samples undoubtedly were not poured over sufficiently to make the serum uniform throughout the entire mass, although the fat was evenly distributed. As the refractive index of the copper serum of milk is higher if the serum is prepared after the sample is sour, the apparent discrepancy is thus accounted for.

Influence of Pasteurization on Milk Serum.

The heating of milk has a tendency to produce a diminution of the refractive index of those milk serums which contain the coagulable albumin. The higher the temperature the greater will be the influence until complete coagulation takes place at about 85° C. or 185° F. The coagulation begins at 64° C. or 147° F., below which apparently it cannot take place in sufficient quantity to affect the serum. The refractive index of the copper and sour serums, the ash of sour serums and the temperature of pasteurization of the samples are given in Table IV.

TABLE IV. — *Influence of Pasteurization upon the Composition of Milk Serum.*

Sample Number.	Refraction of Copper Serum, 20° C.						Refraction of Sour Serum 20° C.					
	Raw.			Pasteurized.			Raw.			Pasteurized.		
	Milk.	Skimmed Milk.	Cream.	Milk.	Skimmed Milk.	Cream.	Milk.	Skimmed Milk.	Cream.	Milk.	Skimmed Milk.	Cream.
I.,	38.0	37.9	38.0	36.4	36.7	37.3	42.0	42.0	41.9	40.3	40.5	42.1
II.,	38.2	38.2	38.3	–	36.5	36.5	42.1	42.2	42.3	–	39.8	39.6
XIII.,	38.5	38.5	38.6	37.2	36.8	37.2	42.8	42.8	–	41.7	–	–
III.,	38.3	38.4	38.3	–	37.0	37.0	43.0	45.7	43.5	–	43.5	40.2
X.,	38.0	38.0	38.0	36.8	36.9	37.4	40.8	40.9	40.9	39.9	40.0	40.7
XIV.,	37.8	37.8	37.9	36.3	36.4	36.9	41.7	41.5	42.7	39.0	39.2	40.2
XII.,	37.3	37.3	37.7	36.3	36.3	36.7	40.8	40.8	–	38.6	41.9	–
XIX.,	38.8	38.9	38.9	37.3	37.0	37.4	43.0	43.8	45.4	40.8	41.1	41.4
XI.,	38.2	38.3	38.5	37.0	37.2	37.0	42.2	42.2	43.5	40.2	40.5	39.8
XVI.,	37.7	37.7	37.5	36.7	36.9	36.7	40.8	41.6	43.7	40.0	40.3	41.7
XX.,	37.1	37.0	37.4	36.4	36.3	36.3	39.5	40.5	41.9	38.3	38.7	38.8
VII.,	38.6	38.6	38.7	–	37.6	37.8	42.0	41.7	42.1	–	40.5	40.7
V.,	37.5	37.4	37.4	36.6	36.5	36.8	40.7	41.4	41.4	39.7	39.7	39.8
IV.,	38.8	38.9	38.8	–	38.5	38.5	42.7	43.4	42.7	–	42.2	41.7
XV.,	38.0	38.1	38.0	37.1	37.0	37.0	42.0	–	–	40.0	–	–
XVII.,	38.0	38.0	38.0	37.3	37.4	37.3	42.3	40.6	43.0	41.4	41.5	42.7

XVIII., ...	37.7	37.9	38.0	37.0	37.0	37.0	41.3	41.6	41.9	40.4	40.8	40.0
VIII., ...	37.6	37.6	38.0	37.2	37.3	37.4	41.0	41.3	41.2	40.2	40.3	40.2
IX., ...	37.5	37.5	38.3	37.3	37.2	38.3	41.4	41.0	42.3	–	40.4	42.4
XXII., ...	37.0	37.0	37.5	36.7	36.7	36.1	39.6	39.9	41.0	38.9	40.1	38.9
XXI., ...	36.7	36.9	37.0	36.0	36.0	36.3	40.0	40.0	40.0	38.7	40.7	38.0
VI., ...	38.6	38.6	38.6	38.4	38.4	38.4	42.2	43.0	43.5	41.7	42.2	44.2

TABLE IV. — *Influence of Pasteurization upon the Composition of Milk Serum* — Continued.

Sample Number.	Ash of Sour Serum, Grams per 100 Cubic Centimeters.						Temperature.		Time of Holding (Minutes).	Fat in —	
	Raw.			Pasteurized.							
	Milk.	Skimmed Milk.	Cream.	Milk.	Skimmed Milk.	Cream.	Degrees C.	Degrees F.		Milk (Per Cent.).	Cream (Per Cent.).
I.,	0.812	0.816	0.824	0.812	0.784	0.840	80	176	30	3.60	–
II.,	0.742	0.740	0.749	–	0.756	–	80	176	30	4.05	21.5
XIII.,	0.790	0.780	–	0.780	–	–	75	167	30	4.70	52.0
III.,	0.801	0.794	0.806	–	0.826	0.794	75	167	30	3.60	16.2
X.,	0.766	0.786	0.786	0.782	0.782	0.810	75	167	30	4.00	25.2
XIV.,	0.796	0.800	0.804	0.788	0.768	0.804	75	167	30	3.40	28.4
XII.,	0.776	0.776	–	0.796	0.792	0.760	75	167	30	3.50	44.0
XIX.,	0.792	0.800	0.800	0.808	0.810	–	74	165	30	3.90	42.5
XI.,	0.788	0.780	0.800	0.788	0.792	0.792	74	165	30	3.85	45.8
XVI.,	0.768	0.780	0.796	0.784	0.776	0.824	74	165	30	4.00	42.0
XX.,	0.752	0.744	0.738	0.748	–	0.748	70	158	30	3.20	34.5
VII.,	0.772	0.752	0.776	–	0.764	0.776	73	163	30	4.10	35.2
V.,	0.820	0.820	0.832	0.816	0.820	0.811	73	163	30	3.70	27.0
IV.,	0.812	0.808	–	–	0.816	0.828	70	158	30	4.20	30.3
XV.,	0.750	–	–	0.762	–	–	75	167	30	3.70	26.0
XVII.,	0.760	0.767	0.771	0.777	0.764	0.774	70	158	30	4.40	28.7

XVIII., ...	0.762	0.764	0.744	0.758	0.760	0.738	74	165	30	3.65	40.0
VIII., ...	0.764	0.756	0.748	0.772	0.764	0.756	70	158	30	3.80	35.5
IX., ...	0.776	0.780	0.771	–	0.780	0.784	70	158	30	–	–
XXII., ...	0.780	0.820	0.748	0.812	0.800	0.765	70	158	30	3.40	35.2
XXI., ...	0.788	0.760	0.758	0.788	0.769	0.748	70	158	30	3.90	36.0
VI., ...	0.802	0.810	0.792	0.821	0.821	0.792	65.6	150	40	4.70	21.0

The diminution of the refractive index of the serum by pasteurization is influenced by the per cent. of fat in the sample as well as by the temperature to which it has been heated. Milk with a high fat content has a high protein content, and milk with a low fat content has a low protein content. A sample of milk containing 5 per cent. fat would contain about 0.7 per cent. coagulable albumin. A sample with 4 per cent. fat would contain about 0.6 per cent. albumin and one with 3 per cent. fat, about 0.5 per cent. albumin. The complete coagulation of the albumin in a sample of milk from a herd of Jersey cows would have more influence in lowering the refractive index of the serum than if the sample was obtained from a herd of Holstein cows. As the milk with a high fat content gives a more concentrated serum than the milk with a low fat content, the influence of heating is less marked in the latter case; in fact, the copper serum and sour serum prepared from boiled milk is more uniform than that prepared from raw milk. The refractive index of the average milk would be reduced to an extent of 1.8 scale divisions by boiling; therefore with a sample of milk containing 5 per cent. fat we should expect a reduction of about 2.1 scale divisions, and with a sample containing 3 per cent. fat, a reduction of 1.3 scale divisions. The influence of both heat and fat content upon the diminution of the refractive index of the copper serum is shown in Table V., the figures being obtained from Table IV.

TABLE V.

Number of Analyses.	Temperature.		Average fat.	Average Difference between Refraction of Copper Serum before and after Heating.
	Degrees C.	Degrees F.		
5,	80	176	4.05	1.70
11,	80	176	3.82	1.40
6,	80	176	3.60	1.20
3,	75	167	4.70	1.11
14,	75	167	3.94	1.11
11,	75	167	3.50	1.10
9,	74	165	3.95	0.90
12,	74	165	3.74	0.85
3,	74	165	3.20	0.80
11,	70	158	4.05	0.73
20,	70	158	3.95	0.63
9,	70	158	3.48	0.54

From the figures in Table IV. the relation between the temperature to which milk is heated and the percentage coagulation of the albumin has been computed, and is shown in Table VI. It should be understood that these figures are somewhat influenced by the duration of time the milk has been kept at the temperature specified.

TABLE VI.

Temperature.		Per Cent. of Albumin coagulated.	Temperature.		Per Cent. of Albumin coagulated.
Degrees C.	Degrees F.		Degrees C.	Degrees F.	
60	140	–	75	167	60
65	149	10	77	171	70
67	153	20	78	172	80
69	156	30	79	174	90
71	160	40	80	176	100
73	163	50			

TABLE VII. — *Reduction of Refractive Index of Copper Serum by Pasteurization, Intermittent Sampling during Process.*

	TEMPERATURE TO WHICH MILK WAS HEATED.																	
Degrees C.,	65.6	70	70	70	73	73	73	74	75	75	80	80						
Degrees F.,	150	158	158	158	163	163	163	165	167	167	176	176						
TEMPERATURE TO WHICH MILK WAS HEATED.	TIME OF HOLDING (MINUTES).																	
	0	0	0	0	0	0	0	0	0	0	0	0	10	20	30	40	60	90
Raw milk,	38.6	37.5	38.8	37.7	37.5	38.6	37.7	38.2	38.0	38.3	38.0	38.2	–	–	–	–	–	–
50° C., 122° F.,	–	37.6	–	–	–	–	–	–	–	–	38.0	–	–	–	–	–	–	–
60° C., 140° F.,	–	37.6	–	–	–	–	–	–	–	–	37.9	–	–	–	–	–	–	–
65.6° C., 150° F.,	38.5	–	–	–	–	–	–	–	–	–	–	–	38.4	38.4	38.4	38.4	38.4	38.0
70° C., 158° F.,	–	37.5	–	–	–	–	–	–	–	–	37.8	–	37.2	37.3	37.3	–	37.3	37.3
70° C., 158° F.,	–	–	38.8	–	–	–	–	–	–	–	–	–	38.7	38.6	38.6	–	38.5	38.3
70° C., 158° F.,	–	–	–	37.7	–	–	–	–	–	–	–	–	37.8	37.7	37.6	–	–	36.9
73° C., 163° F.,	–	–	–	–	37.1	–	–	–	–	–	–	–	37.1	36.8	36.5	–	36.2	36.1
73° C., 163° F.,	–	–	–	–	–	38.4	–	–	–	–	–	–	38.1	38.0	37.8	–	37.7	37.7
73° C., 163° F.,	–	–	–	–	–	–	37.4	–	–	–	–	–	37.2	37.0	37.0	–	36.9	36.6
74° C., 165° F.,	–	–	–	–	–	–	–	37.8	–	–	–	–	37.7	37.4	37.0	–	36.9	36.9
75° C., 167° F.,	–	–	–	–	–	–	–	–	37.5	–	–	–	37.4	37.3	37.0	–	36.9	36.7
75° C., 167° F.,	–	–	–	–	–	–	–	–	–	–	–	–	37.2	37.1	37.0	–	36.9	36.7
80° C., 176° F.,	–	–	–	–	–	–	–	–	–	–	36.9	–	36.4	36.3	36.4	–	36.7	–
80° C., 176° F.,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	36.5	–	36.5	36.4

Average temperature of heating, 72.5° C., 162.5° F.
Average refractive index of serum, 38.1.
Average reduction of serum refraction during heating, 0.46.
Average reduction of serum refraction holding 10 minutes, 0.16.
Average reduction of serum refraction holding 20 minutes, 0.27.
Average reduction of serum refraction holding 30 minutes, 0.39.
Average reduction of serum refraction holding 60 minutes, 0.44.
Average reduction of serum refraction holding 90 minutes, 0.59.

The figures obtained from those samples which were removed during the heating and holding process in order to obtain the relative rate of reduction of the refractive index of the serum are given in tabular form in Table VII.

Judging from the results obtained from known purity milk heated slowly in bulk in the laboratory, we have arrived at the conclusion that practically no chemical effect takes place in milk upon heating until the temperature of 64° C. or 147° F. has been attained. As the temperature increases above this point the albumin gradually becomes insoluble, and the refractive index of the serum decreases until the temperature reaches 85° C. or 185° F., above which (up to the boiling point) no further influence is apparent. The influence of holding is not so marked as that of heating, and the reduction of the refractive index of the serum is less a factor of the length of time than of the temperature, for if the latter is below 64° C. or 147° F. the time of holding is without influence upon the coagulability of the albumin.

Pasteurization is without influence upon the sour serum ash, notwithstanding the fact that the heating of milk above 72° C. or 161° F. causes the precipitation of some of the calcium salts, the exact nature of which is at present a matter of controversy, but which is coincident with the destruction of the peroxidases. The formation of lactic acid during the souring of the milk causes a complete solution of any precipitated mineral matter, and consequently the sour serum ash of pasteurized milk is the same as that obtained from the raw milk.

The term pasteurization as used herein has been somewhat of a misnomer as it has been applied where the terms cooked, boiled or scalded should have been used. Commercial pasteurization is carried out at a temperature of 62.8° C. or 145° F., the milk going to holding chambers where it is kept for from thirty minutes to one hour. Under these circumstances there is practically no coagulation of the albumin, and therefore there is no liability of commercial milk giving a serum of lower concentration than would be obtained from the same milk before heating. If, however, milk has been heated sufficiently to cause any marked diminution of the albumin, it may be detected by performing the peroxidase reaction which will be negative, in which instance a lower figure may be selected for the minimum refractive index.

After the above experiments had been performed and the results compiled, it was decided to investigate the influence of

commercial pasteurization upon milk. Three pasteurization plants near Boston were visited, and samples were taken before and after pasteurization. One plant used the flash system, heating momentarily to 74.4° C. or 16.6° F., and cooling immediately, the entire process from the mixing tank to the bottles taking about one-half minute. In this plant two samples were taken before and two after pasteurization at such an interval of time that the pasteurized samples represented substantially the same milk as the corresponding raw samples. The other plants from which samples were taken used the holding system, the milk being instantaneously heated to 146–147° F. (63.3°–63.9° C.), transferred to holding chambers with a loss of 3 to 4° F., held for a period of thirty minutes with a loss of 1 to 2° F., cooled and bottled. Two samples were taken, one each from the mixing tank, from the outlet of the cooler and the outlet of the holder at such intervals that the raw, heated and held samples were from substantially the same milk. In one instance samples were also taken from the tank where the pasteurized milk was mixed before bottling, and one sample was also taken from the bottling machine. The results of the analyses are shown in Table VIII.

TABLE VIII. — *Influence of Commercial Pasteurization upon Milk.*

Sample Number.	Character of Sample.	Temperature (Degrees F.).	Time held.	Solids (Per Cent.).	Fat (Per Cent.).	Proteins (Per Cent.).	Ash (Per Cent.).	Lactose (Per Cent.).	Copper Serum (Refraction).	Sour Serum (Refraction).	Sour Serum (Ash).	Bacteria per Cubic Centimeter.
1	Raw,	–	–	12.01	3.70	3.11	0.67	4.49	36.5	39.3	0.772	14,000,000
	Pasteurized,	166	10 seconds[1]	12.16	3.70	3.03	0.70	4.57	36.6	39.4	0.769	43,000
2	Raw,	–	–	12.08	3.70	3.18	0.67	4.49	36.5	39.4	0.772	–
	Pasteurized,	166	10 seconds[1]	12.26	3.70	3.03	0.77	4.58	36.7	39.5	0.772	–
3	Raw,	–	–	12.59	3.80	3.17	0.70	4.84	37.2	41.0	0.780	532,000
	Heated,	147	10 seconds[1]	12.55	3.80	3.29	0.70	4.84	37.3	41.3	0.780	90,000
	Pasteurized,	142–3	30 minutes	12.60	3.80	3.24	0.74	4.87	37.2	41.0	0.778	900
4	Raw,	–	–	12.72	3.80	3.38	0.72	4.83	37.2	41.2	0.792	–
	Heated,	147	10 seconds[1]	12.70	3.80	3.22	0.74	4.83	37.2	41.3	0.768	–
	Pasteurized,	142–3	30 minutes	12.60	3.80	3.23	0.70	4.83	37.2	41.0	0.780	–
5	Raw,	–	–	12.90	4.00	3.28	0.72	4.75	37.9	40.8	0.792	402,000
	Heated,	146	10 seconds[1]	12.96	4.00	3.24	0.72	4.76	37.9	41.4	0.788	99,300
	Pasteurized,	143	35 minutes	13.04	3.95	3.32	0.72	4.87	37.9	39.3	0.788	34,000
6	Raw,	–	–	13.04	3.90	3.44	0.77	4.77	37.9	40.8	0.800	353,000
	Heated,	146	10 seconds[1]	13.10	3.95	3.30	0.80	4.85	37.9	40.7	0.800	112,000
	Pasteurized,	143	35 minutes	13.12	4.00	3.32	0.80	4.79	37.9	40.5	0.792	25,000

[1] Approximate estimation.

From these figures it can be a irmed that commercial pasteurization is without substantial influence upon the chemical composition of milk as determined by the methods described in this investigation. As commercial pasteurized milk is not the exclusive product of a two or three cow dairy, but represents the mixed milk of at least 20 dairies of 15 cows each, there is no necessity, for the purpose of measuring the purity of this milk, of applying figures obtained from the milk of a few abnormal cows which were or may have been afflicted with diseased udders. Samples of this variety may possibly be obtained from cows which are under forced rations, for the purpose of obtaining a heavy flow of milk for advanced registry. It is a notable fact that cows that have undergone such treatment have more or less udder troubles, and may not subsequently give normal milk. Commercial pasteurized milk should be compared with the milk from herds of 15 or more cows, and if the analytical constants and ratios are outside of what under these circumstances would be expected, the sample is adulterated, even if it conforms to analyses of many samples of abnormal milk from individual cows.

Conclusions.

The serum of milk, skimmed milk and cream from the same source is identical. Commercial pasteurization is without influence upon the components of milk as determined by the methods employed in this investigation. Heating milk to a temperature of 150° F. or 65° C. and above for a period of three minutes or more will cause a coagulation of the albumin, and consequently a diminution in the concentration of the serum. Commercial pasteurization being always applied to large volumes of milk representing the mixed milk of many herds, it is not essential to use, in judging the quality of such milk, the data obtained from individual cows, but rather from herds. Heating is without influence upon the ash of the serum of sour milk, or of the acetic acid serum of milk.

The thanks of the authors are extended to Miss Katherine E. Rooney, assistant analyst of the State Department of Health, for analytical work in connection with the investigation of the commercial pasteurizing process, and particularly for making the bacteria counts.

Appendix F.

STATUS OF LOCAL MILK INSPECTION.

The data presented in the following pages were obtained, first, from the questionnaire submitted to local boards of health in the spring of 1915; second, from the information gathered by the Food and Drug Division in personal visits to local milk inspectors and agents of local boards of health in the summer of 1915; and third, from repeated correspondence with local boards of health, in which fewer and simpler questions were asked than in the questionnaire, in the early autumn of 1915. The State Department of Health owes its sincere thanks to those employees of local boards of health who have so kindly and accurately answered the questions submitted to them, and also to those who so willingly permitted access to their official records. It is believed that the compilation is as complete as it is possible to obtain, and your Board has on file all the data which it has been able to collect in this State relative to local milk inspection, from which data this compilation has been made.

The varied character of the work done by different local boards of health has rendered it advisable to not only present the compilation alphabetically by cities and towns, but also to divide the cities and towns into sections according to the character of the work done. The first attempt resulted in 25 sections, but after several efforts it was found to be possible to present the data in 16 sections. These sections are arranged in the order of the importance of the work done, and are as follows: —

Section 1. — Cities and towns granting licenses and permits, inspecting dairies and making chemical and bacteriological examinations of milk.

Section 2. — Cities and towns granting licenses and permits, inspecting dairies and making chemical examinations.

Section 3. — Cities and towns having milk inspectors who grant licenses, inspect dairies and make chemical and bacteriological examinations.

Section 4. — Cities and towns granting licenses or permits, inspecting dairies and making chemical and bacteriological examinations.

Section 5. — Cities and towns granting licenses and making chemical and bacteriological examinations.

Section 6. — Cities and towns making chemical and bacteriological examinations only.

Section 7. — Cities and towns granting licenses and permits, inspecting dairies and making bacteriological examinations.

Section 8. — Cities and towns granting licenses, inspecting dairies and making chemical examinations.

Section 9. — Cities and towns granting licenses and making chemical examinations.

Section 10. — Cities and towns granting licenses or permits and inspecting dairies.

Section 11. — Cities and towns having a milk inspector and granting licenses only.

Section 12. — Cities and towns in which the inspector was recently appointed. No work done other than the granting of a few licenses or permits.

Section 13. — Miscellaneous.

Section 14. — Cities and towns having an inspector from whom no reply could be obtained.

Section 15. — Cities and towns doing no milk work under the milk inspection laws.

Section 16. — Cities and towns from which no information could be obtained.

Section 1 comprises 17 cities and towns which carry out the law as the statutes contemplate. From the data given it may be easily ascertained how extensively this work is performed. A bacteriologist can easily make from 50 to 100 bacteria counts per day, and a competent chemist can easily make from 30 to 50 chemical examinations of milk per day. A dairy inspector cannot, as a rule, make more than 15 dairy inspections per day if carefully carried out. In order to effectively supervise the milk supply of a locality, at least one chemical examination and one bacteriological examination should be made each month of the milk of each dealer. Several samples should be taken at each inspection. This work requires the services of trained men, and many localities cannot afford the necessary expense.

The cities and towns listed under section 2 carry out the statutory provisions relative to milk inspection, but make no bacteriological examinations as do those localities of section 1, under their statutory powers to make and enforce bacteriological rules and regulations.

The 22 localities in section 3 effectively protect their communities by the quality of the work performed, but do not grant permits as required by the statutes.

The 5 towns listed in section 4 perform work almost essential in character to those in section 1, but both licenses and permits are not issued.

The 3 towns listed in section 5 do not enforce dairy inspection and permit laws, but if the work done is performed frequently and properly it affords good protection to the inhabitants.

Section 6, with the exception of licensing the dealers, is doing work equivalent to those localities recorded under section 3.

Section 7 consists of 3 towns which are carrying out all the statutory requirements except the making of chemical examinations for the detection of adulterations.

Section 8, comprising 5 localities, makes no bacteriological examinations and issues no permits. The dairy inspections, as a rule, are confined to local dairies.

Section 9 comprises 3 localities, 2 of them being large cities which license the milk dealers and make chemical examinations.

Section 10 comprises 79 cities and towns, and is the largest section except that doing no milk work. It is substantially carrying out the provisions of chapter 744 of the Acts of 1914 relative to dairy inspection. Most of these localities raise their own milk supply, and as the dairies inspected were but few, the records of inspection were not investigated excepting those instances where a large number of dairies were reported to have been inspected. In some instances, however, the dairy inspection was confined to local dairies when the locality imported milk. The dairy inspections were made, in many instances, by the inspector of animals which, while not strictly conforming to the requirements of the statutes, were no doubt done as well as if a special inspector had been appointed for the purpose. In other instances the members of the board of selectmen or the board of health performed the inspection work.

Section 11 consists of 13 localities which have milk inspectors and grant licenses.

Section 12 comprises 8 towns which have recently appointed an inspector of milk. No work has been done other than the granting of a few licenses or permits.

Section 13 comprises 7 localities which are classed as miscellaneous. These localities grant a few permits and one license.

Section 14 comprises 4 towns having a milk inspector from whom no replies could be received from a letter asking for information regarding the character of work done.

Section 15 is the largest section and comprises 159 localities doing no work under the milk inspection laws.

Section 16 comprises 10 towns from which no information could be received in response to numerous inquiries. No doubt these 10 towns belong in group 15, which would raise the number of towns doing no work to 172.

The figures obtained from these cities and towns were collected between May and November during the year 1915. Most localities doing work were eager to allow access to their records, and were therefore investigated early in the year. The figures for dairy inspection obtained from these cities and towns are, therefore, much lower than they would have been had they been collected in October, because the prevalence of the hoof and mouth disease during the winter of 1914–15 had the effect of curtailing the inspection of dairies. This was not resumed until late in the spring of 1915. In fact, many localities did not begin operations under the dairy inspection law of 1914 until the summer of 1915.

In the preparation of this portion of the report for the printer, it was decided to submit to each city and town a statement of what the Department proposed to print. Therefore a letter was sent stating this fact, enclosing a form upon which was stated the name of the State or town, the number of licenses, permits and dairies inspected in 1914 and 1915, the character of the dairy inspection, a statement of the records of dairy inspection, the number of chemical examinations, and the number of bacteriological examinations. The city or town to which this letter was sent was requested to return the statement saying that it was correct, or to return it stating that it was in error, with a statement of how the corrected report should read. After these replies had been received it was ascertained that in a few instances there was a discrepancy between the reports of records of dairy inspection as brought back by our own investigators and as claimed by the local men. In these instances the local men were unable at the time of visits to show any records of their dairy inspections to the Department's employees. A few of the local men have claimed that this was in error, and that they have records on file in the office. Many of the local men, however, admit the correctness of our statements that they had no records of dairy inspection. A large number of cities and towns have made no reply to this last letter submitted.

(A) Summary of Local Milk Inspection, classified by Cities and Towns.

Section 1. Cities and Towns granting Licenses and Permits, inspecting Dairies and making Chemical and Bacteriological Examinations.

Amherst.

16 licenses granted.
16 permits granted.
10 dairies inspected.
120 chemical examinations made.
120 bacteriological examinations made.

Boston.

5,381 licenses granted.
Permits at present being granted.
7,323 dairies inspected.
15,150 chemical examinations made.
6,834 bacteriological examinations made. Records not investigated by reason of the difficulty of the task.

Braintree.

31 licenses granted.
21 permits granted.
31 dairies inspected. The dairies are located in Braintree, Randolph and Weymouth. Dairies of the Barden Cream Company not investigated. Dairy inspection made for general cleanliness and recorded as fair, passed, good, etc.
36 chemical examinations made.
12 bacteriological examinations made.

Brockton.

462 licenses granted.
192 permits granted.
242 dairies inspected, located in Avon, Brockton, Stoughton, Bridgewater, Abington, East Bridgewater and Randolph. Some of these dairies scored exceptionally low, the average of all the dairies being slightly below 50. The bacterial analyses show the milk sold to be of good quality.
1,524 chemical examinations made.
2,080 bacteriological examinations made.

Brookline.

140 licenses granted.
339 permits granted.
354 dairies inspected. Dairy inspection made on special score card. Brookline has inspected the dairies of the large contractors located in New Hampshire, Vermont, Maine and western Massachusetts, and has inspected nearly all the dairies of the smaller dealers. The contractors are obliged to furnish milk from special dairies approved by the agent of the board of health. In doing this work the territory covered by Boston and Newton has been duplicated. Some of the inspections have been made in collaboration with the Newton Board of Health.
470 chemical examinations made.
534 bacteriological examinations made.

Fall River.

741 licenses granted.
407 permits granted.
412 dairies inspected. The dairies are located in Berkley, Dighton, Fall River, Dartmouth, Somerset, Swansea, Rehoboth, Tiverton, R. I., Portsmouth, R. I., Little Compton, R. I., and Warren, R. I. There does not seem to be any duplication of the work by other cities or towns in making these inspections.
214 chemical examinations made.
2,286 bacteriological examinations made.

Haverhill.

42 licenses granted.
110 permits granted.
26 dairies inspected, located in Haverhill and Bradford. No attempt made to inspect dairies outside of the city except one dairy in Salem, N. H. Considerable cream sold by Turner Centre Dairying Association. Dairies not inspected.
314 chemical examinations made.
2,103 bacteriological examinations made.

Lancaster.

9 licenses granted.
40 permits granted.
48 dairies in Lancaster inspected. United States score cards used.
19 chemical examinations made.
32 bacteriological examinations made.

Lawrence.

82 licenses granted.
42 permits granted.
175 dairies inspected, located in Methuen, Andover, North Andover and Dracut. Inspection made for general cleanliness.
217 chemical examinations made.
125 bacteriological examinations made.

Milton.

36 licenses granted. A few permits granted.
25 dairies inspected. Score card used in inspecting dairies located in Milton. Dairies of the H. P. Hood Company, the Elm Farm Company and Barden Cream Company not known or inspected.
297 chemical examinations made.
103 bacteriological examinations made.

Natick.

57 licenses granted.
65 permits granted.
76 dairies inspected, located in Sherborn, Framingham, Ashland, Holliston, Wayland, Dover, Sudbury and Natick.
30 chemical examinations made.
4 bacteriological examinations made.

Newton.

178 licenses granted.
435 permits granted.
666 dairies inspected. Dairies located around Newton, and contractors' dairies in New Hampshire, Vermont and western Massachusetts. Inspections made by United States score cards and records kept. Work of the Boston Board of Health and Brookline Board of Health has been duplicated by Newton. Some of the inspections, however, have been made in collaboration with the Brookline Board of Health.
821 chemical examinations made.
198 bacteriological examinations made.

Somerville.

610 licenses granted.
336 permits granted.
354 dairies inspected. Dairies of large contractors not inspected. Some of the out-of-State dairies of the smaller contractors inspected, going over the territory covered by Newton, Brookline and

Boston. Inspection scores of the State accepted, and also inspections of Boston, Waltham and Arlington when available. The inspector relies more upon microscopical examination and bacteria count of milk than upon dairy inspection.

3,008 chemical examinations made.

1,143 bacteriological examinations made.

Springfield.

732 licenses granted.

78 permits granted. Permits have been issued by regulations of the city Board of Health before the passage of the 1914 law. New permits issued during 1914.

997 dairies inspected. Dairies were inspected by the score card method, the Department covering practically all the dairies supplying milk to the city. Dairies are located in Agawam, Amherst, Becket, Deerfield, Enfield, Granby, Greenfield, Greenwich, Hadley, Hampden, Hardwick, Huntington, Longmeadow, Ludlow, Middlefield, Monson, Montgomery, Palmer, Prescott, Savoy, Southwick, Warren, Washington, Westfield, West Springfield, Whately, Wilbraham and in Ellington, Hazardville, Somers and Suffield, Conn. Springfield reports that the milk from many of these dairies, which was refused admission to Springfield, is being sold in surrounding towns. No other cities or towns have inspected these dairies to the knowledge of the Springfield Board of Health. The territory, however, where the dairies are located has been covered by inspectors of other cities or towns.

2,697 chemical examinations made.

1,120 bacteriological examinations made.

Westfield.

17 licenses granted.

57 permits granted.

110 dairies inspected.

204 chemical examinations made.

23 bacteriological examinations made.

Winchendon.

34 licenses granted.

28 permits granted.

207 dairies inspected. Dairies located in Winchendon. Inspections made by means of United States score card.

297 chemical examinations made consisting of fat and sediment tests.

35 bacteriological examinations made.

Winchester.

49 licenses granted.
38 permits granted.
92 dairies inspected. Inspection made by United States score card method of dairies located in Woburn, Stoneham, Winchester, Short Falls, N. H., Wilton, N. H., and Milford, N. H. The extra-State dairies supply milk to Hood and Whiting.
165 chemical examinations made.
165 bacteriological examinations made.

SECTION 2. CITIES AND TOWNS GRANTING LICENSES AND PERMITS, INSPECTING DAIRIES AND MAKING CHEMICAL EXAMINATIONS.

Amesbury.

63 licenses granted.
42 permits granted.
92 dairies inspected. Dairy inspection consists of examination for general cleanliness.
29 chemical examinations made. Chemical examination for fat only.

Arlington.

82 licenses granted.
12 permits granted.
90 dairies inspected.
200 chemical examinations made.

Athol.

20 licenses granted.
20 permits granted.
30 dairies inspected. Dairies inspected for general cleanliness. Records show dairies to be good or poor.
24 chemical examinations for fat.

Barnstable.

167 licenses granted.
126 permits granted.
169 dairies inspected.
80 chemical examinations consisting of fat and specific gravity. Examinations made for general cleanliness. Rules and regulations of the board of health require all dealers to obtain licenses and pay for the same.

Chicopee.

112 licenses granted.
62 permits granted.
62 dairies inspected. Special card used for inspection on general cleanliness.
285 chemical examinations consisting of fat determination.

Greenfield.

20 licenses granted.
20 permits granted.
35 dairies inspected. Dairies inspected twice a year for general cleanliness. Score card occasionally used.
90 chemical examinations made. Chemical examinations consist of specific gravity and fat.

Hingham.

10 licenses granted.
20 permits granted.
20 dairies inspected. Dairy inspection of general cleanliness confined to dairies in town.
1 chemical examination made.

Hull.

30 licenses granted.
4 permits granted.
4 dairies inspected. Dairy inspection made for general cleanliness. Inspector does not know from how many dairies the town obtains its milk. Dairies of the Deerfoot Farm and Whiting have not been inspected.
70 chemical examinations made. Chemical examinations consist of fat determination.

Montague.

26 licenses granted.
26 permits granted.
4 dairies inspected.
5 or 6 chemical examinations made.

North Adams.

89 licenses granted.
75 permits granted.
182 dairies inspected. United States score card used in inspecting dairies. Dairies are scored in the spring and fall. Nearly all the dairies have been inspected.
340 chemical examinations for fat.

Provincetown.

30 licenses granted.
39 permits granted.
21 dairies inspected, located in Provincetown and Truro. General inspection made and also United States score card used. Inspection made by the State at the request of the Provincetown Board of Health.
14 chemical examinations made.

Wakefield.

22 licenses granted.
22 permits granted.
12 dairies inspected. Dairies located in Exeter and Epping, N. H., North Reading, Lynnfield, Wakefield and Melrose.
100 chemical examinations made.

Ware.

55 licenses granted.
64 permits granted.
142 dairies inspected. Dairies inspected every three months but not scored.
488 chemical examinations for fat.

Woburn.

107 licenses granted.
105 permits granted to those taking out licenses.
111 dairies inspected. Dairies of D. Whiting & Co. not inspected.
111 chemical examinations made consisting of fat and specific gravity.

Section 3. Cities and Towns having Milk Inspectors who grant Licenses, inspect Dairies and make Chemical and Bacteriological Examinations.

Belmont.

41 licenses granted.
61 dairies inspected, located in 10 different cities and towns in the State.
230 chemical examinations made.
230 bacteriological examinations made.
Records not investigated.

Cambridge.

700 licenses granted
23 dairies (local) inspected.
2,300 chemical examinations made.
842 bacteriological examinations made.

Canton.

25 licenses granted.
Permits granted on strength of previous year's examination.
29 dairies inspected, located in Canton and Stoughton.
209 chemical examinations made.
228 bacteriological examinations made.

Chelsea.

261 licenses granted.
18 dairies inspected. Inspection limited to local dairies. The bulk of the milk sold in Chelsea comes from the large contractors.
226 chemical examinations made.
61 bacteriological examinations made.

Cohasset.

12 licenses granted.
6 dairies inspected, located in Cohasset and Scituate.
10 chemical examinations made.
29 bacteriological examinations made.

Concord.

15 licenses granted.
15 dairies inspected, located in Concord and Littleton.
5 chemical examinations made.
1 bacteriological examination made.

Dedham.

24 licenses granted.
51 dairies inspected, located in Dedham, Westwood, Norwood, Dover and Needham.
226 chemical examinations made.
51 bacteriological examinations made.

Fitchburg.

110 licenses granted.
114 dairies inspected.
377 chemical examinations made.
76 bacteriological examinations made.

Framingham.

29 licenses granted.
87 dairies inspected, located in Framingham, Holliston, Ashland, Sudbury and Wayland.
150 chemical examinations made.
232 bacteriological examinations made.

Gardner.

43 licenses granted.
120 dairies inspected, located in Gardner, Winchendon, Ashburnham, Westminster, Hubbardston, Templeton, Phillipston, East Jaffrey, N. H., and East Rindge, N. H.
379 chemical examinations made.
48 bacteriological examinations made.

Holyoke.

454 licenses granted. 20 permits refused.
265 dairies inspected, located in Holyoke, Amherst, Sunderland, Westfield, Southampton, Hadley, Granby, Belchertown, South Deerfield, Whately and Hatfield. These inspections, however, were made by the State Department of Health at the request of the Holyoke Board of Health. Local board now making all dairy inspections.
2,543 chemical examinations made.
40 bacteriological examinations made.

Lynn.

587 licenses granted.
1,034 dairies inspected, located in cities and towns surrounding Lynn, dairies in Maine including Auburn and Lewiston, also dairies in the neighborhood of Portsmouth, N. H. General inspection of dairies show the dairy to be good, fair and poor.
2,024 chemical examinations made.
320 bacteriological examinations made.

Malden.

261 licenses granted.
190 dairies inspected; 75 per cent. of the milk comes from out of the State, and the dairies have not been inspected by the city of Malden.
563 chemical examinations made.
103 bacteriological examinations made.

Medford.

183 licenses granted.
15 dairies inspected.
237 chemical examinations made.
3 bacteriological examinations made.

Melrose.

71 licenses granted.
45 dairies inspected, located in Melrose, Saugus, Wakefield, Reading and Wilmington. The large contractors furnish about one-quarter of the milk supply, and these dairies have not been inspected.
285 chemical examinations made.
356 bacteriological examinations made.

New Bedford.

452 licenses granted.
181 dairies inspected. The inspection limited to local dairies except in rare cases. Score card used, records as shown refer to dairies as good, fair, etc.
24 chemical examinations made.
698 bacteriological examinations made.

Quincy.

193 licenses granted.
68 dairies inspected located in Quincy. Dairies of the large contractors not inspected; recorded as good, fair, poor, very poor, etc. Some marked "very poor" are apparently selling milk.
8 chemical examinations made.
8 bacteriological examinations made.

Revere.

18 licenses granted.
8 local dairies inspected for general sanitary conditions. Dairies of large contractors who furnish most of the milk not inspected.
124 chemical examinations made.
62 bacteriological examinations made.

Salem.

239 licenses granted.
80 dairies inspected. United States score card used in inspecting dairies.
874 chemical examinations made.
874 bacteriological examinations made.

Taunton.

84 licenses granted.
195 dairies inspected, located in Taunton, Dighton, Berkley, Raynham, Norton and Rehoboth; recorded as good, fair, etc.
100 chemical examinations for fat.
75 bacteriological examinations made.

Waltham.

152 licenses granted.
180 dairies inspected, located in Waltham, Lexington, Lincoln, Bedford, Wilmington, Weston, Wayland, Sudbury, Stow, Boxborough, Harvard, Littleton, Acton and Groton.
1,400 chemical examinations made.
427 bacteriological examinations made.

Worcester.

193 licenses granted.
200 dairies inspected. United States score card used.
1,653 chemical examinations made.
281 bacteriological examinations made.

Section 4. Cities and Towns granting Licenses or Permits, inspecting Dairies and making Chemical and Bacteriological Examinations.

Clinton.

53 licenses granted.
66 dairies inspected. United States score card used. Good records.
50 chemical examinations made.
133 bacteriological examinations made.

Watertown.

72 licenses granted.
27 dairies inspected.
339 chemical examinations made.
113 bacteriological examinations made.

Wellesley.

34 licenses granted.
43 dairies inspected.
87 chemical examinations made.
153 bacteriological examinations made.

Westborough.

55 permits granted.
55 dairies inspected. Inspector is a veterinarian.
20 chemical examinations made. Chemical examinations limited to fat, specific gravity and sediment test.
25 bacteriological examinations made.

Weston.

13 licenses granted.
24 dairies inspected.
43 chemical examinations made.
125 bacteriological examinations made.

Section 5. Cities and Towns granting Licenses and making Chemical and Bacteriological Examinations.

Needham.

11 licenses granted.
48 chemical examinations made.
87 bacteriological examinations made.

Swampscott.

44 licenses issued.
58 chemical examinations made.
24 bacteriological examinations made.

Winthrop.

51 licenses granted.
130 chemical and bacteriological examinations made.

Section 6. Cities and Towns making Chemical and Bacteriological Examinations only.

Walpole.

35 chemical examinations made.
35 bacteriological examinations made.

Section 7. Cities and Towns granting Licenses and Permits, inspecting Dairies and making Bacteriological Examinations.

Scituate.

16 licenses granted.
22 permits granted.
7 dairies inspected, location in Scituate. General inspection made. Records show dairies to be very good or good.
7 bacteriological examinations made.

Stoneham.

50 licenses granted.
52 permits granted.
18 dairies inspected. Dairies of large contractors not inspected.
100 bacteriological examinations made.

Whitman.

17 licenses granted.
27 permits granted.
32 dairies inspected. Dairy inspection made for general cleanliness. Records show dairies to be good, poor or fair.
38 bacteriological examinations made.

SECTION 8. CITIES AND TOWNS GRANTING LICENSES, INSPECTING DAIRIES AND MAKING CHEMICAL EXAMINATIONS.

Adams.

26 licenses granted.
45 dairies inspected. Dairy inspection for general cleanliness.
150 chemical examinations for fat.

Attleboro.

32 licenses granted.
65 dairies inspected. Dairy inspection carried on by United States score card. Records shown to investigator. Laboratory apparatus consisting of babcock machine, balance platinum dishes.
33 chemical examinations made.

Beverly.

164 licenses granted.
34 dairies inspected. Unable to state from how many different dairies the city obtains its milk.
64 chemical examinations made.

Lexington.

44 licenses granted.
20 dairies inspected.
100 chemical examinations made.

Pittsfield.

68 licenses granted.
40 dairies inspected. Dairy inspection consists of inspection for general cleanliness. Recorded as fair, bad and good. Dairy inspection confined to Pittsfield.
300 chemical examinations for fat.

SECTION 9. CITIES AND TOWNS GRANTING LICENSES AND MAKING CHEMICAL EXAMINATIONS.

Everett.

335 licenses granted.
700 chemical examinations made.

Lowell.

600 licenses granted.
2,226 chemical examinations made.

Plainville.

9 licenses granted.
48 chemical examinations for fat.

SECTION 10. CITIES AND TOWNS GRANTING LICENSES OR PERMITS AND INSPECTING DAIRIES.

Acton.

16 licenses granted.
16 permits granted.
16 dairies inspected.

Acushnet.

4 licenses granted.
14 permits granted.
14 dairies inspected.
Inspector appointed May 10, 1914.

Ashby.

3 permits granted.
3 dairies inspected.

Ashland.

17 permits granted.
14 dairies inspected, located in Ashland and Hopkinton.

Avon.

21 permits granted.
24 dairies inspected.

Barre.

32 permits granted.
32 dairies inspected.

Belchertown.

3 permits granted.
3 dairies inspected. Records not investigated.

Bellingham.

2 permits granted.
5 dairies inspected. Records not investigated.

Boxford.

13 permits granted.
13 dairies inspected. Records not investigated.

Bridgewater.

21 licenses granted.
4 permits granted.
8 dairies inspected, located in Bridgewater. Most of the dairies inspected reported as clean, fairly clean, etc.

Buckland.

7 permits granted.
7 dairies inspected. Records not investigated.

Charlemont.

5 permits granted.
5 dairies inspected.

Chilmark.

20 permits granted.
20 dairies inspected. General inspection passable or not passable.

Conway.

1 license granted.
1 permit granted.
1 dairy inspected.

Dalton.

3 licenses granted.
10 permits granted.
12 dairies inspected. United States score cards used.

Dana.

7 permits granted.
7 dairies inspected. General inspection.

Danvers.

51 licenses granted.
58 permits granted.
60 dairies inspected.

Dover.

10 permits granted.
10 dairies inspected. Inspection made for general cleanliness.

Duxbury.

94 permits granted.
94 dairies inspected. Dairies inspected by United States score card and records kept. Nearly all the dealers have permits.

East Longmeadow.

3 licenses granted.
14 dairies inspected.

Eastham.

38 permits granted.
38 dairies inspected.

Easthampton.

17 licenses granted.
7 dairies inspected.

Edgartown.

26 permits granted.
26 dairies inspected. Inspection made in collaboration with Dairy Bureau.

Foxborough.

29 permits granted.
25 dairies inspected. Records not investigated.

Gloucester.

123 licenses granted.
44 permits granted.
112 dairies inspected, located in Gloucester, Rockport, Essex, Ipswich and Manchester.

Gosnold.

4 permits granted.
4 dairies inspected.

Great Barrington.

18 licenses granted.
24 dairies inspected.
Inspection made by means of score card.

Groton.

77 permits granted.
77 dairies inspected.

Halifax.

11 licenses granted.
4 permits granted.
11 dairies inspected.

Hamilton.

11 dairies inspected.

Hanson.

10 permits granted.
10 dairies inspected.

Holland.

2 or 3 licenses granted.
2 or 3 dairies inspected.

Hopkinton.

54 permits granted.
44 dairies inspected.

Hudson.

14 licenses granted.
14 dairies inspected.

Ipswich.

29 licenses granted.
46 dairies inspected. Inspection for general cleanliness.

Lee.

Number of permits issued not recorded.
175 dairies inspected. Inspection made for general cleanliness.

Lenox.

11 licenses granted.
24 dairies inspected. The dairies are scored for general cleanliness. The inspector is also a policeman.

Ludlow.

30 licenses granted.
60 permits granted.
60 dairies inspected. Town obtains milk from 8 different towns, but all of these dairies have been inspected by the Springfield Board of Health.

Marblehead.

79 licenses granted.
27 local dairies inspected. Dairies visited two or three times a year. Score card used in making inspections. Only local dairies inspected.

Marion.

10 permits granted.
5 dairies inspected.

Marlborough.

73 licenses granted.
10 dairies inspected.
The city obtains its milk from 55 different dairies, and also obtains milk from the Deerfoot Farm.

Maynard.

11 licenses granted.
25 dairies inspected. Recommendations made to dairymen at the time of visit.

Medway.

34 permits granted.
34 dairies inspected. Records not investigated.

Middleborough.

85 licenses and permits granted.
88 dairies inspected.

Millis.

3 permits granted.
3 dairies inspected. Records not investigated.

Monson.

10 licenses granted.
3 dairies inspected.

Nantucket.

37 licenses granted.
37 permits granted.
26 dairies inspected, located in Nantucket.

North Attleborough.

50 licenses granted.
12 permits granted.
58 dairies inspected.

North Brookfield.

7 licenses granted.
16 permits granted.
20 dairies inspected.

North Reading.

33 permits granted.
29 dairies inspected.

Northampton.

55 licenses granted.
114 permits granted.
125 dairies inspected, located in Northampton and surrounding towns. Inspections made by United States score cards and complete records available.

Norton.

130 permits granted.
130 dairies inspected.

Norwell.

65 permits granted.
65 dairies inspected. Score cards used.

Norwood.

4 licenses granted.
43 permits granted.
43 dairies inspected, located in Norwood. Inspection made by United States score cards and records available.

Orange.

36 permits granted.
36 dairies inspected. General inspection for cleanliness. Recorded as passed or not passed.

Orleans.

50 permits granted.
50 dairies inspected. Records not investigated.

Palmer.

70 licenses granted.
70 permits granted.
135 dairies inspected, located in Palmer, Belchertown, Monson and Ware. General inspection made and dairies recorded as fair, good or bad.

Peabody.

98 licenses granted.
19 permits granted.
100 dairies inspected. No data kept of inspection; figures given to the investigator entirely from memory. Dairies inspected are located in Peabody.

Petersham.

8 permits granted.
24 dairies inspected. United States score cards used. Records of scores on file.

Plymouth.

51 licenses granted.
60 dairies inspected.

Rowley.

41 permits granted.
41 dairies inspected.

Salisbury.

26 licenses granted.
18 dairies inspected.

Sandwich.

10 permits granted.
20 dairies inspected. Inspection for general cleanliness made.

Saugus.

59 licenses granted.
59 permits granted.
43 local dairies inspected. Inspections made for general cleanliness.

Sherborn.

94 licenses granted.
94 dairies inspected. Records not investigated.

Shirley.

11 permits granted.
11 dairies inspected.

Somerset.

1 license granted.
All dairies inspected.

Southbridge.

29 licenses granted.
37 permits granted.
30 dairies inspected. Dairy inspections made by United States score cards. Dairies located in Sturbridge, Charlton, Southbridge. Records on file.

Spencer.

16 licenses granted.
27 permits granted.
27 dairies inspected, located in Spencer and Leicester. Records of inspection not investigated.

Stockbridge.

19 licenses granted.
19 permits granted.
19 dairies inspected.

Stoughton.

2 licenses granted.
31 permits granted.
33 dairies inspected. One dairy located in Sharon, the balance in Stoughton. Four dairies reported in bad condition. Records not shown to investigator.

Sturbridge.

20 permits granted.
Records not investigated.

Sunderland.

2 permits granted.
2 dairies inspected.

Uxbridge.

5 permits granted.
5 dairies inspected. Records not investigated.

Wareham.

26 licenses granted.
81 permits granted.
80 dairies inspected by inspector of animals.

West Boylston.

4 permits granted.
7 dairies inspected. Records not investigated.

Westport.

15 permits granted.
15 dairies inspected.

Williamstown.

8 licenses granted.
24 permits granted.
24 dairies inspected.

Wilmington.

24 permits granted.
19 dairies inspected.

SECTION 11. CITIES AND TOWNS HAVING A MILK INSPECTOR AND GRANTING LICENSES ONLY.

Andover.
Ashburnham.
Ayer.
Fairhaven.
Falmouth.
Leominster.
Methuen.
Rockland.
Topsfield.
Warren.
West Springfield.
Westwood.
Weymouth.

SECTION 12. CITIES AND TOWNS IN WHICH THE INSPECTOR WAS RECENTLY APPOINTED. NO WORK DONE OTHER THAN THE GRANTING OF A FEW LICENSES OR PERMITS.

Billerica.

Inspector recently appointed. Records not investigated.

Franklin.

Milk inspector reports that no work has been done. Inspector appointed during the summer of 1915.

Grafton.

Inspector appointed during the summer of 1915.
8 dairies inspected.

Lunenburg.

No licenses or permits granted. No dairies inspected. Inspector stated that no appropriation was made to carry out the work.

Marshfield.

Inspector appointed in the spring of 1915 and has done no work.

Northborough.

Inspector recently appointed. No work done.

Pepperell.

12 licenses granted.
12 permits granted. Records not investigated.

Randolph.

Inspector recently appointed.

SECTION 13. MISCELLANEOUS.

Becket.

No inspector.
1 license granted. Records not investigated.

Milford.

Some dairies inspected.

Newburyport.

44 licenses granted.
400 bacteriological examinations made.

Plympton.

18 permits granted.

Rowe.

10 dairies inspected.

Southampton.

No inspector.
4 permits granted.

Upton.

7 permits. No dairies inspected.

SECTION 14. CITIES AND TOWNS HAVING AN INSPECTOR FROM WHOM NO REPLY COULD BE OBTAINED.

Carlisle.	South Hadley.
Rutland.	Sutton.

SECTION 15. CITIES AND TOWNS DOING NO MILK WORK UNDER THE MILK INSPECTION LAWS.

Abington.	Colrain.	Hancock.
Agawam.	Cummington.	Hanover.
Alford.	Dartmouth.	Hardwick.
Ashfield.	Deerfield.	Harvard.
Auburn.	Dennis.	Harwich.
Bedford.	Dighton.	Hatfield.
Berkley.	Douglas.	Hawley.
Berlin.	Dracut.	Heath.
Bernardston.	Dudley.	Hinsdale.
Blackstone.	Dunstable.	Holbrook.
Blandford.	East Bridgewater.	Holden.
Bourne.	Egremont.	Holliston.
Boxborough.	Enfield.	Hopedale.
Boylston.	Erving.	Hubbardston.
Brewster.	Essex.	Huntington.
Brimfield.	Florida.	Kingston.
Brookfield.	Freetown.	Lakeville.
Burlington.	Georgetown.	Lanesborough.
Carver.	Gill.	Leicester.
Charlton.	Goshen.	Leverett.
Chatham.	Granby.	Leyden.
Chelmsford.	Granville.	Lincoln.
Cheshire.	Greenwich.	Longmeadow.
Chester.	Groveland.	Lynnfield.
Chesterfield.	Hadley.	Manchester.
Clarksburg.	Hampden.	Mansfield.

Mashpee.
Mattapoisett.
Medfield.
Mendon.
Merrimac.
Middlefield.
Middleton.
Monroe.
Monterey.
Montgomery.
Mount Washington.
Nahant.
New Ashford.
New Braintree.
New Marlborough.
New Salem.
Newbury.
Norfolk,
North Andover.
Northbridge.
Northfield.
Oak Bluffs.
Oakham.
Otis.
Oxford.
Pelham.
Pembroke.
Peru.
Phillipston.
Plainfield.
Prescott.
Raynham.
Reading.
Rehoboth.
Richmond.
Rochester.
Rockport.
Royalston.
Russell.
Sandisfield.
Savoy.
Seekonk.
Sharon.
Sheffield.
Shelburne.
Shrewsbury.
Shutesbury.
Southborough.
Southwick.
Sterling.
Stow.
Swansea.
Templeton.
Tewksbury.
Tisbury.
Tolland.
Townsend.
Truro.
Tyngsborough.
Tyringham.
Wales.
Warwick.
Washington.
Wayland.
Webster.
Wellfleet.
Wendell.
West Bridgewater.
West Brookfield.
West Newbury.
West Stockbridge.
West Tisbury.
Westford.
Westhampton.
Westminster.
Whately.
Wilbraham.
Windsor.
Worthington.
Wrentham.
Yarmouth.

Section 16. Cities and Towns from which no Information could be obtained.

Bolton.
Easton.
Gay Head.
Littleton.
Millbury.
Paxton.
Princeton.
Sudbury.
Wenham.
Williamsburg.

(B) Summary of Local Milk Inspection.

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses.	Licenses.		Permits.		Dairies Inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Abington,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Acton,	10	–	–	–	–	16	–	16	–	16	–	–	–
Acushnet,	12	Bancroft Windsor,	None,	–	–	4	–	14	–	14	Official score card,	–	–
Adams,	8	A. G. Potter,	Babcock,	$150	26	18	–	–	45	–	General cleanliness,	150	–
Agawam,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Alford,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Amesbury,	2	James L. Stewart,	Babcock and lactometer,	–[2]	4	63	42	21	40	92	General cleanliness,	29	–
Amherst,	1	A. F. Bardwell,	Complete,	–	16	13	16	13	10	–	General cleanliness,	120	120
Andover,	11	Franklin H. Stacey,	–	80	30	32	–	–	–	–	–	–	–
Arlington,	2	L. L. Pierce,	Chemical and bacteriological.	50	82	73	12	–	90	12	–	200	–
Ashburnham,	11	J. F. Hare,	–	–	10	9	–	–	–	–	–	–	–
Ashby,	10	Dr. J. S. Lamkin,	–	–	–	–	–	3	–	3	–	–	–
Ashfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Ashland,	10	Horace H. Piper,	None,	–	–	–	17	–	14	–	–	–	–
Athol,	2	Joseph H. Meaney,	Babcock and lactometer,	50	20	–	20	–	30	30	General cleanliness,	24	–
Attleboro,	8	Solomon Fine,	Babcock, lactometer, balance and dishes.	–	–	32	–	–	–	65	Official score card,	33	–

[1] No work done.

[2] Less than $100.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Auburn,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Avon,	10	–	–	–	–	–	–	21	–	24	–	–	–
Ayer,	11	Edward E. Sawyer,	–	–	–	11	–	–	–	–	–	–	–
Barnstable,	2	George T. Mecarta,	Lactometer and Babcock,	300	167	126	2	126	169	167	General cleanliness,	80	–
Barre,	10	None,	None,	–	–	–	32	5	32	5	–	–	–
Becket,	13	None,	None,	–	1	1	–	–	–	–	–	–	–
Bedford,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Belchertown,	10	–	None,	–	–	–	3	–	3	–	–	–	–
Bellingham,	10	None,	None,	–	–	–	2	–	5	–	–	–	–
Belmont,	3	Thomas F. Harris,	Good,	–	41	39	–	–	55	61	Official score card,	230	230
Berkley,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Berlin,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Bernardston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Beverly,	8	Henry E. Dodge, Jr.,	None,	450	164	113	–	–	30	34	General cleanliness,	64	–
Billerica,	12	A. H. Jones,	None,	–	–	–	–	–	–	–	Inspector recently appointed.	–	–
Blackstone,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Blandford,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Bolton,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–

Boston,	1	James O. Jordan,	Adequately equipped,	–	5,381	5,140	–	–	5,136	7,323	Official score card,	15,150	6,834	
Bourne,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	
Boxborough,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	
Boxford,	10	None,	–	–	–	–	13	13	13	13	–	–	–	–
Boylston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Braintree,	1	Dr. F. H. Gile,	Chemical and bacteriological.	150	31	21	–	21	31	7	General cleanliness,	36	12	
Brewster,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Bridgewater,	10	Joseph Brennon,	–	–	17	21	–	4	–	8	–	–	–	–
Brimfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Brockton,	1	George E. Bolling,	Good,	2,400	462	137	192	–	242	48	Official score card,	1,524	2,080	
Brookfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Brookline,	1	W. E. Ward,	Good,	3,053	137	140	244	339	337	354	Special score card,	470	534	
Buckland,	10	Dr. John G. Greaves,	–	–	–	–	–	7	–	7	–	–	–	–
Burlington,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Cambridge,	3	William A. Noonan,	Good,	2,300	700	700	23	19	23	18	–	–	2,300	842
Canton,	3	Robert N. Hoyt,	Good,	300	25	18	–	–	20	29	–	–	209	223
Carlisle,	14	Benjamin N. Blaisdell.	No reply from inspector,	–	–	–	–	–	–	–	–	–	–	–
Carver,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Charlemont,	10	None,	–	–	–	–	5	–	5	–	–	–	–	–
Charlton,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Chatham,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Chelmsford,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–

[1] No work done.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Chelsea,	3	William S. Walkley,	Good,	625	261	202	–	–	18	17	– –	226	61
Cheshire,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Chester,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Chesterfield,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Chicopee,	2	Charles J. O'Brien,	Babcock and lactometer,	500	89	112	62	–	62	40	General cleanliness,	285	–
Chilmark,	10	None,	– –	–	–	–	–	20	–	20	– –	–	–
Clarksburg,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Clinton,	4	G. L. Chase,	– –	550	53	30	–	–	66	–	Official score card,	50	133
Cohasset,	3	Darius N. Gilbert,	Babcock and bacteria,	100	12	–	–	–	6	2	– –	10	29
Colrain,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Concord,	3	Joseph Dee, Jr.,	Babcock,	50	9	15	–	–	9	15	– –	5	1
Conway,	10	– –	– –	–	1	1	1	1	All	All	– –	–	–
Cummington,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Dalton,	10	H. Ward Ford,	– –	–	–	3	–	10	–	12	General cleanliness,	–	–
Dana,	10	Frank Crawford,	– –	–	–	–	7	7	7	7	– –	–	–
Danvers,	10	Hugo Nappe,	None (Dr. Lamb of Revere).	150	47	51	–	58	60	60	– –	–	–
Dartmouth,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Dedham,	3	Dr. Edward Knobel,	Good equipment,	600	23	24	–	–	51	20	– –	226	51

Deerfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dennis,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dighton,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Douglas,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dover,	10	Charles S. Bean,	–	–	–	–	–	–	10	–	10	–	–	–	–	–
Dracut,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dudley,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dunstable,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Duxbury,	10	Charles Eaton,	–	–	–	–	–	–	94	–	94	–	–	–	–	–
East Bridgewater,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
East Longmeadow,	10	Henry Ashley,	None (done in Springfield).		–	–	3	–	–	–	14	–	–	–	–	–
Eastham,	10	–	–	–	–	–	–	–	38	–	38	–	–	–	–	–
Easthampton,	10	George L. McEvoy,	–	–	250	17	17	–	–	7	–	–	–	–	–	–
Easton,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Edgartown,	10	George N. Cleveland,	–	–	–	–	–	26	26	26	26	–	–	–	–	–
Egremont,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Enfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Erving,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Essex,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Everett,	9	E. Clarence Colby,	Good chemical,		1,125	335	235	–	–	–	–	General cleanliness,		700	–	
Fairhaven,	11	Dr. Andrew N. Bruckshaw.	–	–	–	22	22	–	–	–	–	–	–	–	–	

[1] No work done.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses.	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Fall River,	1	Henry Boisseau,	Chemical and bacteriological.	4,880	680	741	–	407	400	412	Official score card,	214	2,286
Falmouth,	11	None,	–	–	30	–	–	–	–	–	–	–	–
Fitchburg,	3	J. F. Bresnahan,	Good equipment,	650	110	87	–	–	114	–	–	377	76
Florida,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Foxborough,	10	Percy W. Alexander,	–	–	–	–	29	–	25	–	–	–	–
Framingham,	3	Robert N. Hoyt,	–	425	28	29	–	–	43	87	–	150	232
Franklin,	12	J. Newton Blanchard,	None,	–	–	–	–	–	–	–	Inspector appointed in 1915.	–	–
Freetown,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Gardner,	3	Clifford W. Shippee,	–	1,500	38	43	–	–	120	119	–	379	48
Gay Head,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–
Georgetown,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Gill,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Gloucester,	10	George Watson,	–	150	123	116	44	2	112	42	Score card,	–	–
Goshen,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Gosnold,	10	John T. Cornell,	–	–	–	–	–	4	–	4	–	–	–
Grafton,	12	–	None,	10	–	–	–	–	8	–	Inspector appointed one month ago.	–	–
Granby,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Granville,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–

Great Barrington,	10	De Witt Smith,	–	225	18	18	–	–	–	24	Score card,	–	–
Greenfield,	2	George P. Moore,	Babcock and lactometer,	–	17	20	–	20	35	–	Official score card,	90	–
Greenwich,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Groton,	10	Board of Health,	None,	–	–	–	–	77	–	77	–	–	–
Groveland,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hadley,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Halifax,	10	–	–	–	–	11	–	4	–	11	–	–	–
Hamilton,	10	–	–	–	–	–	–	–	–	11	Not investigated. No replies received from letters until Aug. 9, 1916.	–	–
Hampden,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hancock,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hanover,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hanson,	10	–	–	–	–	–	–	10	–	10	–	–	–
Hardwick,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Harvard,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Harwich,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hatfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Haverhill,	1	H. L. Conner, M.D.,	Lactometer, Babcock and bacteria.	$1,000	42	39	–	110	–	26	Official score card,	314	2,103
Hawley,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Heath,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hingham,	2	Dr. C. A. Dorr,	None,	100	10	–	–	20	10	20	General cleanliness,	1	–
Hinsdale,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–

[1] No work done.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Holbrook,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Holden,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Holland,	10	None,	–	–	–	2 or 3	–	–	–	2 or 3	–	–	–
Holliston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Holyoke,	3	Daniel P. Hartnett,	Good,	2,200	454	362	–	–	225	265	–	2,543	40
Hopedale,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hopkinton,	10	Board of Health,	–	–	–	–	44	54	44	–[2]	–	–	–
Hubbardston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Hudson,	10	William H. Clark,	None,	1,350	14	12	–	–	14	12	–	–	–
Hull,	2	Carroll A. Cleverly,	Chemical and bacteriological.	125	30	29	–	4	–	4	Score card,	70	–
Huntington,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Ipswich,	10	George W. Smith,	None,	200	25	29	–	5	46	–	General cleanliness,	–	–
Kingston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Lakeville,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Lancaster,	1	George E. Howe,	None,	100	9	8	–	40	13	48	Official score card,	19	32
Lanesborough,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Lawrence,	1	J. H. Tobin, M.D.,	Good,	1 800	82	51	–	42	175	50	General cleanliness,	217	125
Lee,	10	J. H. McAllister,	None,	–	–	–	–	–	175	–	General cleanliness,	–	–

Leicester,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lenox,	10	Thomas Braiant,	None,	250	11	10	–	–	24	10	General cleanliness,	–	–		
Leominster,	11	W. H. Dodge,	None,	–	27	27	–	–	–	–	–	–	–	–	
Leverett,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Lexington,	8	L. L. Pierce,	None,	25	44	41	–	–	–	20	–	–	100	–	
Leyden,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Lincoln,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Littleton,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–	–	
Longmeadow,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Lowell,	9	Melvin F. Master,	Chemical and bacteriological.	3,000	600	474	–	–	–	–	–	–	2,226	–	
Ludlow,	10	–	–	Babcock,	–	26	30	–	60	8	60	Official score card,	–	–	
Lunenburg,	12	Charles A. Woods,	None,	–	–	–	–	–	–	–	No appropriation to carry out work.	–	–		
Lynn,	3	George A. Flanagan,	Good,	–	540	587	–	–	765	1,034	General cleanliness,	2,024	320		
Lynnfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Malden,	3	Joseph A. Sanford,	Good,	–	261	63	–	–	190	50	–	–	563	103	
Manchester,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Mansfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Marblehead,	10	Andrew M. Stone,	None,	150	79	50	–	–	27	27	Official score card,	–	–		
Marion,	10	–	–	–	–	–	–	10	–	5	–	–	–	–	
Marlborough,	10	John J. Cassidy,	None,	–	73	54	–	–	–	10	General cleanliness,	–	–		
Marshfield,	12	Inspector appointed in 1915.	–	–	–	–	–	10	–	5	–	–	–	–	

[1] No work done.

[2] Not stated.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Mashpee,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Mattapoisett,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Maynard,	10	Joshua Edwards,	None,	–	11	11	–	–	25	25	General cleanliness,	–	–
Medfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Medford,	3	Winslow Joyce,	Good chemical,	700	183	181	–	–	15	5	General cleanliness,	237	3
Medway,	10	Physician of Board,	–	–	–	–	34	–	34	–	–	–	–
Melrose,	3	Robert N. Hoyt,	–	500	71	45	–	–	–	45	–	285	356
Mendon,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Merrimac,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Methuen,	11	None,	–	–	–	5	–	–	–	–	No inspection work done.	–	–
Middleborough,	10	T. F. Conway,	None (Dr. Bolling, Brockton).	100	42	85	–	85	–	88	–	–	–
Middlefield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Middleton,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Milford,	13	–	–	–	–	–	–	–	–	–	Some dairies inspected.	–	–
Millbury,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–
Millis,	10	None,	–	–	–	–	–	3	–	3	–	–	–
Milton,	1	Wallace C. Tucker,	None (private chemist),	500	36	33	–	–[2]	25	15	Official score card,	297	103
Monroe,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–

Monson,	10	E. W. Capen,	Babcock,	5	10	5	–	–	3	–	Superficial,	–	–
Montague,	2	Frank X. Dubie,	None (samples sent to Greenfield).	–	26	–	26	–	–[3]	4	General cleanliness,	5 or 6	–
Monterey,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Montgomery,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Mount Washington,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Nahant,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Nantucket,	10	Warren B. Chase,	None,	–	–	37	–	37	26	–	Official score card,	–	–
Natick,	1	Thomas A. Doyle,	None,	300	57	37	30	65	–	76	Official score card,	30	4
Needham,	5	Robert N. Hoyt,	Good chemical and bacteriological.	–	11	11	–	–	–	–	Official score card,	48	87
New Ashford,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
New Bedford,	3	Dr. Herbert Hamilton.	Babcock and bacteria,	–	452	–	–	–	181	126	General cleanliness,	24	698
New Braintree,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
New Marlborough,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
New Salem,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Newbury,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Newburyport,	13	R. D. Hamilton,	Bacteria,	900	44	40	–	–	–	–	– –	–	400
Newton,	1	Arthur Hudson,	Good chemical and bacteriological.	650	178	172	–	435	427	666	Official score card,	821	198
Norfolk,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
North Adams,	2	C. T. Quackenbush,	Fair chemical,	250	89	85	75	–	75	182	Official score card,	340	–
North Andover,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
North Attleborough,	10	Dr. Hugh Gaw,	None,	250	50	35	12	10	58	50	General cleanliness,	–	–
North Brookfield,	10	– –	– –	–	–	7	–	16	–	20	Official score card,	–	–

[1] No work done. [2] Some. [3] No records available.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
North Reading,	10	– –	– –	–	–	–	–	33	–	29	– –	–	–
Northampton,	10	George R. Turner,	Babcock,	350	52	55	–	114	–	125	Official score card,	–	–
Northborough,	12	Everett C. Valentine,	– –	–	–	–	–	–	–	–	– –	–	–
Northbridge,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Northfield,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Norton,	10	Edmund H. Elliot,	– –	–	–	–	–	130	–	130	– –	–	–
Norwell,	10	J. F. Wilder,	None,	–	–	–	–	65	–	65	– –	–	–
Norwood,	10	Dr. G. W. Derrick,	None,	–	4	–	43	–	43	–	Official score card,	–	–
Oak Bluffs,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Oakham,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Orange,	10	Hartly R. Walker,	None,	–	–	–	–	36	36	36	– –	–	–
Orleans,	10	Chairman, Board of Health.	None,	–	–	–	–	50	–	50	– –	–	–
Otis,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Oxford,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–
Palmer,	10	Dr. M. H. Davitt,	None,	120	67	70	6	70	135	100	General cleanliness,	–	–
Paxton,	16	No reply,	– –	–	–	–	–	–	–	–	– –	–	–
Peabody,	10	Edward McHugh,	None,	156	98	80	–	19	100	25	General cleanliness,	–	–
Pelham,[1]	15	– –	– –	–	–	–	–	–	–	–	– –	–	–

Pembroke,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pepperell,	12	F. A. Davis,	None,	–	12	–	12	–	–	–	–	–	–	–	–	–
Peru,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Petersham,	10	Lorin A. Barnes,	None,	–	–	–	–	8	–	24	–	–	–	–	–	–
Phillipston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pittsfield,	8	Bernard M. Collins,	Babcock, centrifuge, bacteria.	250	68	53	–	–	40	35	General cleanliness,			300	–	
Plainfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Plainville,	9	–	Babcock,	30	–	9	–	–	–	–	–	–	–	48	–	
Plymouth,	10	None,	–	–	–	51	–	–	60	–	–	–	–	–	–	
Plympton,	13	–	–	–	–	–	–	18	–	–	–	–	–	–	–	
Prescott,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Princeton,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–	–	–	
Provincetown,	2	John Dennis,	None,	–	–	30	–	39	8	21	–	–	–	14	–	
Quincy,	3	Daniel Scouler, Jr.,	None,	300	165	193	–	–	68	56	General cleanliness,			8	8	
Randolph,	12	Inspector recently appointed.	–	–	–	–	–	–	–	–	–	–	–	–	–	
Raynham,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Reading,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Rehoboth,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Revere,	3	Joseph E. Lamb,	Good chemical,	–	14	18	–	–	8	8	Local only,			124	62	
Richmond,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Rochester,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Rockland,	11	Joseph Frame, M.D.,	None,	–	31	27	–	–	–	–	–	–	–	–	–	

[1] No work done.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses.	Licenses.		Permits.		Dairies Inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Rockport,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Rowe,	13	–	–	–	–	–	–	–	8	10	–	–	–
Rowley,	10	–	–	–	–	–	–	41	–	41	–	–	–
Royalston,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Russell,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Rutland,	14	Board of Health,	No other reply,	–	–	–	–	–	–	–	–	–	–
Salem,	3	John J. McGrath,	Babcock and bacteria,	2,060	239	200	–	–	80	8	Official score card,	874	874
Salisbury,	10	John F. Pike,	None,	–	26	26	–	–	–	18	–	–	–
Sandisfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Sandwich,	10	Joshua E. Holway,	None,	–	–	–	10	3	20	–	General cleanliness,	–	–
Saugus,	10	Arthur W. Sawyer,	Lactometer and lactoscope.	90	59	29	59	29	43	–	General cleanliness,	–	–
Savoy,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Scituate,	7	George T. Otis,	–	50	16	16	–	22	7	7	–	–	7
Seekonk,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Sharon,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Sheffield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Shelburne,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Sherborn,	10	Board of Health,	None,	–	–	94	–	–	–	94	–	–	–
Shirley,	10	–	–	–	–	–	–	11	–	11	–	–	–

Shrewsbury,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Shutesbury,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Somerset,	10	–	–	–	–	–	1	–	–	–	All	–	–	–
Somerville,	1	Herbert E. Bowman,	Good chemical and bacteriological.	2,300	598	610	–	336	160	354	Official score card,	3,008	1,143	
South Hadley,	14	George Boudreau,	Inspector made no reply to letter.	–	–	–	–	–	–	–	–	–	–	
Southampton,	13	None,	–	–	–	–	4	4	–	–	–	–	–	
Southborough,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	
Southbridge,	10	Albert R. Brown,	None,	–	28	29	–	37	30	37	Official score card,	–	–	
Southwick,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	
Spencer,	10	Earl C. Spencer,	None,	–	16	–	27	–	27	–	–	–	–	
Springfield,	1	S. C. Downs,	Good chemical and bacteriological.	4,651	732	727	51	78	997	939	Official score card,	2,697	1,120	
Sterling,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	
Stockbridge,	10	Dr. Webster Miller,	None,	85	19	–	19	–	19	–	Official score card,	–	–	
Stoneham,	7	Lawrence E. Doucett,	None,	100	49	50	–	52	–	18	General cleanliness,	–	100	
Stoughton,	10	William E. Ferrin,	None,	–	–	2	–	31	–	33	–	–	–	–
Stow,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–
Sturbridge,	10	Board of Health,	–	–	–	–	20	–	–	–	–	–	–	–
Sudbury,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–	–
Sunderland,	10	None,	–	–	–	–	2	–	2	–	–	–	–	–
Sutton,	14	Charles A. Howe,	Inspector did not reply to letter.	–	–	–	–	–	–	–	–	–	–	–
Swampscott,	5	Herbert D. Smith,	None,	100	44	42	–	–	–	–	General cleanliness,	58	24	
Swansea,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–

[1] No work done.

(B) Summary of Local Milk Inspection — *Continued.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies Inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Taunton,	3	Lewis I. Tucker,	Babcock and bacteria,	650	84	80	-	-	195	85	General cleanliness,	100	75
Templeton,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Tewksbury,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Tisbury,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Tolland,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Topsfield,	11	C. S. Moore,	-	-	-	-	-	-	-	-	-	-	-
Townsend,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Truro,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Tyngsborough,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Tyringham,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Upton,	13	-	-	-	-	-	-	7	-	-	-	-	-
Uxbridge,	10	None,	-	-	-	-	5	-	5	-	-	-	-
Wakefield,	2	Carl M. Smith,	Babcock and lactometer,	200	-	22	-	22	-	12	Official score card,	100	-
Wales,[1]	15	-	-	-	-	-	-	-	-	-	-	-	-
Walpole,	6	None,	Work sent out,	-	-	-	-	-	-	-	-	35	35
Waltham,	3	Dr. A. L. Stone,	Good chemical and bacteriological	1,145	39	152	-	-	180	42	Official score card,	1,400	427
Ware,	2	F. E. Marsh,	Babcock and lactometer,	275	36	55	-	64	125	142	General cleanliness,	488	-
Wareham,	10	J. J. Beaton,	None,	50	26	21	-	81	80	75	-	-	-
Warren,	11	Joseph F. St. George,	None,	50	10	6	-	-	-	-	-	-	-

Warwick,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	
Washington,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Watertown,	4	–	–	Chemical and bacteriological.	–	–	72	–	–	–	27	Official score card,	339	113	
Wayland,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Webster,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Wellesley,	4	R. N. Hoyt,		Chemical and bacteriological.	–	25	34	–	–	–	43	Official score card,	87	153	
Wellfleet,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Wendell,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Wenham,	16	No reply,		–	–	–	–	–	–	–	–	–	–	–	–
West Boylston,	10	A. M. Tyler,		–	–	–	4	4	–	–	6	7	–	–	–
West Bridgewater,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
West Brookfield,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
West Newbury,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
West Springfield,	11	Norman T. Smith,		Babcock,		75	44	14	–	–	–	–	–	–	–
West Stockbridge,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
West Tisbury,[1]	15	–	–		–	–	–	–	–	–	–	–	–	–	–
Westborough,	4	Charles H. Reed,		Babcock and lactometer,		150	–	–	55	55	55	55	General cleanliness,	20	25
Westfield,	1	William M. Porter,		Babcock and lactometer,		–	16	17	55	57	103	110	General cleanliness,	204	23
Westford,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Westhampton,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Westminster,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Weston,	4	Robert N. Hoyt,		None,		–	13	12	–	–	–	24	Official score card,	43	125

[1] No work done.

(B) Summary of Local Milk Inspection — *Concluded.*

Locality.	Section.	Name of Inspector.	Laboratory Facilities.	Annual Expenses	Licenses.		Permits.		Dairies inspected.		Character of Inspection.	Chemical Examination.	Bacteriological Examination.
					1914.	1915.	1914.	1915.	1914.	1915.			
Westport,	10	–	–	–	–	–	–	15	–	15	–	–	–
Westwood,	11	–	–	–	–	17	–	–	–	–	–	–	–
Weymouth,	11	Geo. B. Bayley,	–	–	–	60	–	–	–	–	Inspector recently appointed.	–	–
Whately,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Whitman,	7	Dr. E. Alden Dyer,	None (sends to Mr. Bolling, Brockton).	50	–	17	–	27	–	32	General cleanliness,	–	38
Wilbraham,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Williamsburg,	16	No reply,	–	–	–	–	–	–	–	–	–	–	–
Williamstown,	10	G. S. Jordan,	None,	–	8	8	24	–	24	–	–	–	–
Wilmington,	10	None,	–	–	–	–	24	29	15	19	–	–	–
Winchendon,	1	G. W. Stanbridge,	Babcock and lactometer and centrifuge, bacteria.	285	34	27	–	28	207	182	Official score card,	297	35
Winchester,	1	Maurice Dinneen,	Chemical and bacteriological.	500	49	41	–	38	92	80	Official score card,	165	165
Windsor,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Winthrop,	5	Smith A. Mowry,	None,	300	51	49	–	–	–	–	–	130	130
Woburn,	2	Daniel F. Callahan,	Babcock, lactometer and centrifuge bacteria.	350	76	107	–	105	–	111	General cleanliness,	111	–
Worcester,	3	Gustaf L. Berg,	Chemical and bacteriological.	2,600	193	172	–	–	200	50	Official score card,	1,653	281
Worthington,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Wrentham,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–
Yarmouth,[1]	15	–	–	–	–	–	–	–	–	–	–	–	–

[1] No work done.

Appendix G.

STATISTICS OF MILK TRANSPORTATION INTO BOSTON.

Amount of Milk transported into Boston during 1906 (Quarts).

	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.
January,	1,332,604	6,147,201	1,857,863
February,	1,205,300	5,320,639	1,699,607
March,	1,536,120	6,134,064	1,837,624
April,	1,587,060	6,051,116	1,902,188
May,	1,769,768	6,596,392	1,876,023
June,	1,759,177	6,964,326	1,913,221
July,	1,695,886	6,640,927	1,724,948
August,	1,630,869	6,372,150	1,610,180
September,	1,541,245	6,369,436	1,623,933
October,	1,524,968	6,266,043	1,686,887
November,	1,383,409	5,812,806	1,598,172
December,	1,382,567	6,054,571	1,638,630
	18,348,973	74,729,671	20,969,276

Amount of Milk transported into Boston during 1907 (Quarts).

January,	1,386,749	6,211,815	1,586,577
February,	1,239,827	5,523,853	1,516,558
March,	1,445,484	6,248,497	1,705,893
April,	1,472,430	6,185,519	1,828,261
May,	1,638,766	6,425,503	2,008,164
June,	1,691,241	6,487,446	2,080,381
July,	1,648,596	6,669,955	1,933,398
August,	1,452,650	5,970,386	1,807,663
September,	1,170,560	5,574,826	1,708,373
October,	1,333,905	5,037,707	1,821,845
November,	1,117,282	5,087,587	1,788,725
December,	1,174,929	5,171,399	1,817,197
	16,772,419	70,594,493	21,603,035

Amount of Milk transported into Boston during 1908 (Quarts).

	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.
January,	1,241,221	5,293,584	1,934,791
February,	1,178,499	4,925,676	1,822,678
March,	1,147,551	5,695,014	2,013,002
April,	1,328,558	5,254,103	1,987,127
May,	1,524,713	5,536,851	2,029,476
June,	1,541,900	5,857,026	1,985,393
July,	1,349,026	5,964,741	1,858,796
August,	1,299,259	5,785,903	1,817,954
September,	1,317,270	5,493,163	1,806,924
October,	1,318,707	5,347,172	1,984,437
November,	1,169,345	5,017,521	1,840,372
December,	1,246,882	5,316,584	1,927,122
	15,662,931	65,487,338	23,008,072

Amount of Milk transported into Boston during 1909 (Quarts).

January,	1,270,903	5,033,372	1,985,717
February,	1,154,657	4,666,690	1,985,717
March,	1,328,015	5,161,949	2,146,038
April,	1,394,808	5,520,840	2,130,839
May,	1,457,053	6,273,596	2,227,183
June,	1,436,432	6,230,925	2,308,070
July,	1,367,055	5,925,875	2,259,036
August,	1,229,491	6,408,328	2,166,728
September,	1,090,133	5,202,991	2,070,207
October,	1,295,629	5,677,456	2,322,280
November,	1,184,849	5,496,995	2,221,723
December,	1,239,835	5,448,159	2,376,820
	15,448,860	67,047,176	26,161,126

Amount of Milk transported into Boston during 1910 (Quarts).

	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.
January,	1,261,493	5,271,660	2,511,295
February,	1,129,956	4,839,106	2,238,771
March,	1,308,125	5,475,064½	2,528,599
April,	1,319,982	6,343,029	2,410,224
May,	278,791	5,218,864	2,388,932
June,	965,608	5,638,992	2,266,220
July,	1,165,639	5,599,752	2,411,087
August,	891,673	4,679,669	2,037,164
September,	904,062	4,444,055	1,881,451
October,	943,466	4,482,585	2,004,881
November,	799,828	3,938,947	1,962,578
December,	837,902	3,893,803	1,891,326
	11,806,525	59,825,526½	26,532,528

Amount of Milk transported into Boston during 1911 (Quarts).

January,	954,991	3,920,531	1,943,600
February,	778,233	3,810,408	1,798,264
March,	947,997	3,874,625	2,005,974
April,	970,421	4,162,647	1,819,823
May,	1,000,904	4,581,592	2,007,567
June,	1,059,773	4,742,762	2,023,276
July,	814,939	6,206,046	1,702,749
August,	807,635	5,138,598	1,918,993
September,	794,337	5,285,888	1,910,729
October,	904,345	5,492,557	1,795,274
November,	1,042,719	5,675,805	1,578,739
December,	957,011	5,684,134	1,681,167
	11,033,305	58,575,593	22,186,155

Amount of Milk transported into Boston during 1912 (Quarts).

	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.
January,	699,099	5,640,697	1,746,433
February,	663,677	5,463,501	1,660,086
March,	778,999	5,959,732	1,798,682
April,	784,973	5,887,748	1,669,220
May,	999,002	5,926,088	1,630,478
June,	852,059	6,448,720	1,718,713
July,	1,323,508	6,389,101	1,468,410
August,	1,065,419	6,367,389	1,478,834
September,	1,044,702	6,622,503	1,446,076
October,	907,501	6,801,240	1,472,292
November,	1,114,468	6,534,098	1,354,856
December,	651,882	6,916,685	1,422,419
	10,885,289	74,957,502	18,866,499

Amount of Milk transported into Boston during 1913 (Quarts).

January,	429,311	7,179,151	1,446,881
February,	380,481	6,693,732	1,439,468
March,	444,513	7,377,392	1,546,405
April,	442,251	7,438,618	1,475,735
May,	500,943	7,732,448	1,748,368
June,	465,740	7,520,704	1,662,461
July,	451,915	7,430,444	1,725,201
August,	436,862	6,820,345	1,612,586
September,	490,677	6,151,288	1,550,894
October,	550,381	5,913,873	1,594,625
November,	586,978	5,578,902	1,505,290
December,	564,660	6,290,180	1,501,612
	5,744,712	82,127,077	18,809,526

Amount of Milk transported into Boston during 1914 (Quarts).

	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.
January,	296,935	6,604,900	1,502,442
February,	288,116	6,043,261	1,475,780
March,	372,194	6,629,606	1,640,016
April,	393,512	6,373,612	1,829,712
May,	395,019	7,091,511	1,896,857
June,	445,397½	7,471,728	1,906,124
July,	395,257½	7,109,790	1,716,631
August,	506,954	6,717,219	1,498,746
September,	652,448	6,279,826	1,450,443
October,	306,271	6,349,448	1,539,926
November,	293,700	6,182,944	1,625,447
December,	584,223¼	6,427,270	1,743,196
	4,930,027¼	79,281,115	19,825,320

Appendix H.

REPLIES TO QUESTIONNAIRE RELATIVE TO LOCAL MILK INSPECTION.

In April, 1915, a list of 18 questions was sent to local boards of health. These questions are as follows: —

1. What is the amount of your appropriation for milk inspection?
2. Have you a milk inspector?
3. If so, how many milk licenses has he issued during the past year?
4. What laboratory facilities have you for examining milk?
5. How many chemical examinations of milk were made?
6. How many bacteriological examinations of milk were made?
7. How many permits were granted under chapter 744, Acts of 1914?
8. How many permits were refused under chapter 744, Acts of 1914?
9. How many licenses or permits were granted to owners of dairies of five cows or less?
10. What is the total number of dairies in your town?
11. What is the total number of dairy cows in your town?
12. From how many different dairies does your town obtain its milk?
13. How many dairies were inspected under chapter 744, Acts of 1914?
14. In what cities or towns were these dairies located?
15. Were any of these dairies inspected by the boards of health of any city or town other than your town?
16. If so, how many?
17. Were there any epidemics attributed to milk during the past year?
18. Describe the nature of any such epidemic, the number of cases, and state whether or not it was investigated by a State Inspector of Health.

Of the 353 cities and towns 72 made no reply up to September 1. The replies from the balance have been carefully compiled, with the results stated below.

Question 1. — What is the amount of your appropriation for milk inspection?

No answer,	72
No appropriation,	196
Appropriation not specified,	22
Specific appropriation,	63

The specific appropriations are distributed as follows: —

Less than $100,	16
Between $100 and $500,	24
Between $500 and $1,000,	9
Between $1,000 and $2,000,	6
Between $2,000 and $2,500,	5
Between $3,000 and $4,600,	4

The cities and towns stating that the appropriation was not specified are as follows: Amherst, Attleboro, Belmont, Boston, Chicopee, Dalton, East Bridgewater, Framingham, Gloucester, Great Barrington, Greenfield, Lancaster, Ludlow, Lynn, Marblehead, Medway, New Bedford, Orange, Palmer, Petersham, Wellesley and Weston.

Most of these localities spent but little money upon milk inspection, but the following cities maintain good laboratories for several employees, and spend a large amount of money per annum for this proposition: Boston, Lynn and New Bedford.

The following cities and towns have specific appropriations; those in italics spend more than $1,000 per annum: Adams, Andover, Arlington, Barnstable, Beverly, Blackstone, Braintree, *Brockton, Brookline, Cambridge,* Canton, Chelsea, Clinton, Cohasset, Concord, Danvers, Dedham, East Longmeadow, *Everett, Fall River,* Fitchburg, Gardner, Gosnold, *Haverhill, Holyoke,* Hudson, Hull, Ipswich, *Lawrence, Lowell,* Marlborough, Melrose, Middleborough, Milton, Montague, Natick, Needham, Newton, North Adams, North Attleborough, North Brookfield, Northampton, Rowe, *Salem,* Saugus, Scituate, *Somerville, Springfield,* Taunton, Walpole, *Waltham,* Ware, Wareham, Warren, Watertown, West Brookfield, Westborough, Winchendon, Winchester, Winthrop, Woburn and *Worcester.*

Question 2. — Have you a milk inspector?

No replies,	72
Yes,	115
No,	166
	353

The following cities and towns from which no reply was received are known to have milk inspectors: Lexington, Malden, Medford, Newburyport, Pittsfield, Quincy, Revere, Westfield.

Question 3. — If so, how many milk licenses has he issued during the past year?

No reply,	72
None,	177
Balance,	104
Total licenses issued,	16,521

The total licenses issued throughout the State are, of course, much greater than this, as each town and city having a milk inspector failing to reply to this questionnaire issued more or less licenses. The total number of licenses is probably 1,200 to 1,500 more.

The number of licenses per town are distributed as follows: —

Between 1 and 25,	33
Between 25 and 50,	27
Between 50 and 100,	19
Between 100 and 200,	9
Between 200 and 400,	4
Between 400 and 800,	9
Between 800 and 1,600,	1
5,381,	1
	103

Of these 103 cities and towns 79, or 76.7 per cent., issued less than 100 licenses, total number of licenses being 2,603; 24, or 23.3 per cent. of these cities and towns issued more than 100 licenses per town, the total number of licenses being 13,918. The average number of licenses was 158. In those issuing less than 100 licenses the average number was 33; in those issuing more than 100 licenses, the average number issued was 681.

Question 4. — What laboratory facilities have you for examining milk?

No reply,	72
None,	235
Balance,	46
	353

Chemical and bacteriological apparatus complete,	18
Babcock machine,	11
Babcock, lactometer and bacteriological outfit,	4

Babcock and bacteriological outfit,	3
Babcock, sediment tester and bacteriological outfit,	3
Chemical laboratory,	3
Babcock and lactometer,	2
Babcock and sediment tester,	1
Sediment tester,	1
	46

Some localities send samples to commercial chemists or to other milk inspectors. With but few exceptions the outfits are meager.

Question 5. — How many chemical examinations of milk were made?

No reply,	72
None,	222
Balance,	59
	353

Between 1 and 25 analyses,	6
Between 25 and 50 analyses,	7
Between 50 and 100 analyses,	9
Between 100 and 200 analyses,	5
Between 200 and 400 analyses,	15
Between 400 and 800 analyses,	8
Between 800 and 1,600 analyses,	3
Between 1,600 and 3,200 analyses,	5
Between 3,200 and 6,400 analyses,	–
Between 6,400 and 12,800 analyses,	–
15,150,	1

	Towns.	Total Analyses.	Average per Town.
Reports of analyses,	59	41,370	700
Less than 100 analyses,	22	748	36
Between 100 and 1,000 analyses,	27	10,586	335
Between 1,000 and 15,150 analyses,	8	29,848	3,731
Between 1,000 and 2,697 analyses,	7	14,698	2,100

In nearly all places where less than 100 analyses were made during the year the only determination made was the fat and possibly the specific gravity.

Question 6. — How many bacteriological examinations of milk were made?

No reply,	72
None,	237
Balance,	44
	353

Between 1 and 25 analyses,	6
Between 25 and 50 analyses,	6
Between 50 and 100 analyses,	8
Between 100 and 200 analyses,	6
Between 200 and 400 analyses,	8
Between 400 and 800 analyses,	4
Between 800 and 1,600 analyses,	2
Between 1,600 and 3,200 analyses,	3
Between 3,200 and 6,400 analyses,	–
6,834,	1

	Towns.	Total Analyses.	Average per Town.
Reports of analyses,	44	21,532	490
Less than 100 analyses,	20	854	43
Between 100 and 1,000 analyses,	19	10,586	555
Between 1,000 and 6,834 analyses,	5	14,324	2,865
Between 1,000 and 2,286 analyses,	4	7,490	1,872

11 places make chemical but not bacteriological examinations.
4 places make bacteriological but not chemical examinations.

Question 7. — How many permits were granted under chapter 744, Acts of 1914?

The answer to this question shows that with but few exceptions practically no action was taken under this statute. This was attributed in many instances to the prevalence of the hoof and mouth disease, whereby inspections of the dairies was rendered impossible, but it was disregarded more often by reason of the expense which would have occurred, possibly through lack of appropriations and possibly because it would be considered poor policy to spend the money required to carry out the provision of the act. Furthermore, many cities and towns rely to a large extent upon the inspection made by other cities in their neighbor-

hood when the milk supply to all these localities comes from a common source.

No reply,	72
None,	223
Balance,	58 [1]
	353

Of these localities —
31 issued less than 25 permits.
15 issued from 25 to 50 permits.
10 issued from 50 to 100 permits.
1 issued 132 permits.
1 issued 285 permits.
The total permits were 1,840, an average per place of 32.

Of those 12 localities issuing more than 50 permits 1,103 were issued with an average of 93 permits per locality. Of the 46 towns issuing less than 50 permits per town, 417 permits were issued, averaging 9 permits per town. The town reporting the issuing of 132 permits had inspected only 45 dairies. The law under which these permits are issued requires that they shall be issued only after an inspection of the premises and the conditions under which the milk is produced.

Question 8. — How many permits were refused under chapter 744, Acts of 1914?

Eighteen localities refused 53 permits, as follows: —

Duxbury,	14	Needham,	3
Brookline,	6	Edgartown,	2
Natick,	5	Fitchburg,	2
Plymouth,	4	Newton,	2
Dedham,	3	Winchester,	2
Lynn,	3		

Chicopee, Dalton, Pepperell, Southbridge, Spencer, Winchester and Yarmouth 1 each.

Question 9. — How many licenses or permits were granted to owners of dairies of 5 cows or less?

After the answers to this question had been compiled it was discovered that there was a misunderstanding in the meaning of

[1] Issued permits.

the question. It was the intention to obtain the number of dairies having only 5 cows or less and not buying milk from other people. The answers given included many dealers who were in the milk business and in addition owned a few cows.

Question 10. — What is the total number of dairies in your town?
Question 11. — What is the total number of dairy cows in your town?

The answers to these two questions were not compiled because so many rural towns made no reply. Unfortunately this information was greatly desired by the Milk Board in order to ascertain the number of dairies and dairy cows in the State, and in order to assist it in choosing localities for visiting. Many of these towns making no replies, as has been since ascertained, did so by reason of the fact that they carried on no inspection work, and were of the opinion that a reply would be of no value to the Department.

Question 12. — From how many different dairies does your town obtain its milk?

The answers to this question when first compiled gave a total of 54,000 dairies, but there was undoubtedly considerable duplication in the figures, and this was still further made apparent after the answers to question 13 were compiled. For this reason a second compilation was made for the purpose of carefully avoiding any duplication. The number of dairies reported by the city of Boston were used as representing the combined dairies supplying Boston, Cambridge, Somerville, Chelsea and the other cities surrounding Boston, and, in short, an attempt was made to count the dairies of the large contractors but once. This idea was carried through the entire list, and the second compilation gave 17,284 as the total number of dairies supplying the State, of which 8,700 do not furnish milk to Boston and vicinity. These figures are not by any means accurate, but are as close an approximation as can be made from the returns given. Undoubtedly the dairy figures are somewhat low.

Question 13. — How many dairies were inspected under chapter 744, Acts of 1914?

The first compilation of the answer to this question showed that but 7 per cent. of the dairies supplying milk to Massachusetts have been inspected. These figures were again compiled

for the reason described above, and on the second compilation the total dairies inspected were estimated to be 10,318, about 3,000 of which were inspected by cities and towns other than Boston, the city of Boston inspecting nearly all the dairies from which its milk supply is obtained.

Question 14. — In what cities or towns were these dairies located?

The responses to this question show that with the exception of a few large cities and towns the dairy inspection was confined to local dairies, the Inspection Department making no attempt to go out of town for the purpose of inspecting dairies from which the town received its milk.

Question 15. — Were any of these dairies inspected by the boards of health of any city or town other than your town?

Question 16. — If so, how many?

These questions were introduced for the purpose of ascertaining how much actual duplication of milk inspection existed in this State. A study of the law would certainly convince one that at least one-half of the dairies supplying milk to the cities and towns in this State should have been inspected by the boards of health of from 3 to 10 different cities and towns. The compilation of the answers has shown that there was but little duplication of inspection, notwithstanding the fact that many towns replied yes to question 15. In these cases, however, nearly all the milk raised was shipped out of town, and the entire inspection made under these conditions was naturally made by the board of health of the town where the milk was sold, and not the town where the milk was produced, and furthermore, in nearly all these cases the local boards of health made no inspection whatsoever. Owing to the fact that except in the case of the largest cities practically no inspection of foreign dairies is made, the duplication of inspection which one would expect to occur is lacking. Furthermore, communities rely to a large measure on the inspection of other cities and towns to safeguard their own milk supply. For example, Revere, Chelsea, Winthrop and Melrose make no attempt to inspect the premises of the producers supplying the large contractors, but depend upon the inspection made by the city of Boston. In a similar manner the town of Methuen depends almost entirely upon the inspection made by the city of Lawrence, because the milk supply of both places comes, practically, from the same

source. One town replied that they made no inspection at all, but depended upon those made by the State Board of Health. The town of Brookline reports that the city of Boston inspected nearly two-thirds of the dairies inspected by Brookline. Newton has inspected many of the dairies inspected by Boston and Brookline. The city of Somerville has duplicated some of the Boston work. No doubt all the cities and towns receiving nearly their entire supply from the large contractors could have made the same report if they had carried out the provisions of chapter 744 of the Acts of 1914.

Question 17. — Were there any epidemics attributed to milk during the past year?

Question 18. — Describe the nature of any such epidemic, the number of cases, and state whether or not it was investigated by a State Inspector of Health.

Mansfield. — Typhoid fever in August, September and October, 29 cases. Typhoid fever in March and April, 1915, 21 cases. Investigated by Dr. McKnight of Fall River and Dr. Kelley of Boston. Dr. Kelley and Miss Beckler know all the conditions of affairs in these two epidemics.

Natick. — One place where scarlet fever was found and one dairy where there was a case of typhoid was investigated by the State Inspector besides our Board and Dairy Inspector on our request.

Weymouth. — Twenty-six cases of typhoid fever on one milk supply. No deaths. Investigated by the State Board of Health.

Beverly. — One epidemic; the milk from New Hampshire dairy discontinued. Investigated same and discontinued milk supply coming to Beverly. The disease was typhoid fever. The State Inspector visited Beverly a number of times.

Boston. — Two epidemics, septic sore throats. First outbreak in Dorchester, 295 cases; second outbreak, 275. Investigated by Dr. Champion.

Brookline. — One epidemic of septic sore throat, — about 20 cases. Not investigated by State Inspector of Health. Such drastic action was taken that the milk dealer immediately went out of the milk business.

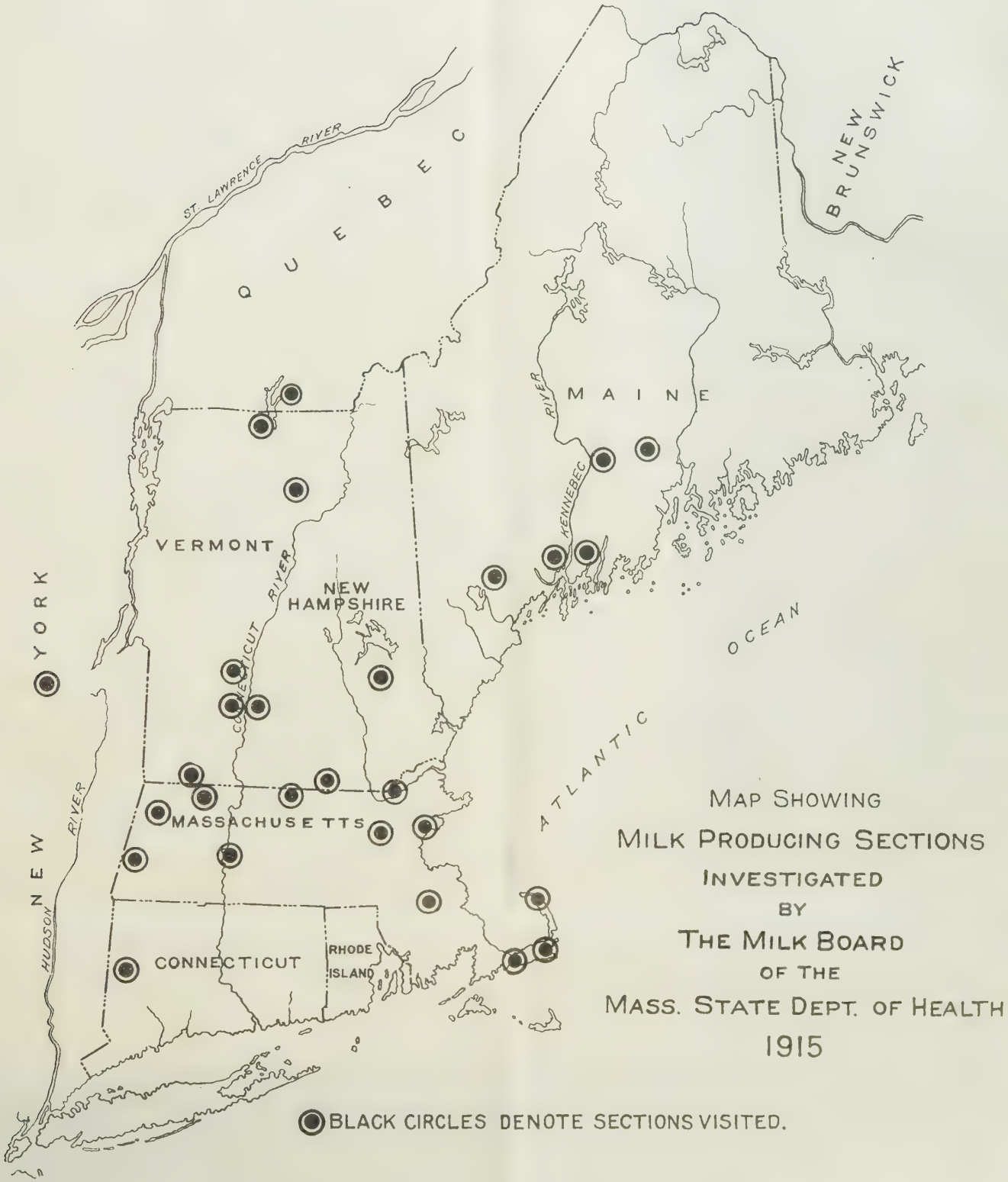
Leominster. — There was one typhoid fever epidemic with 12 cases which was investigated by Dr. Louis Fish of Fitchburg.

North Adams. — One epidemic of typhoid fever. Something like 50 cases were investigated by Dr. Lyman Asa Jones.

New Bedford. — Two epidemics which might have been due to milk. Inspected by local authorities and precautions taken.

Shirley. — Three cases of scarlet fever investigated by Dr. Simpson.

Winthrop. — Several cases of septic sore throat reported from one dealer. Took samples of milk and went to State House. Story told to


ST. LAWRENCE RIVER
QUEBEC
NEW BRUNSWICK
MAINE
KENNEBEC RIVER
VERMONT
NEW HAMPSHIRE
CONNECTICUT RIVER
NEW YORK
HUDSON RIVER
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
ATLANTIC OCEAN
MAP SHOWING
MILK PRODUCING SECTIONS
INVESTIGATED
BY
THE MILK BOARD
OF THE
MASS. STATE DEPT. OF HEALTH
1915
BLACK CIRCLES DENOTE SECTIONS VISITED.

Dr. Hanson; 26 cases of septic sore throat; made notes, and sent me to Harvard Medical, Longwood Avenue, for test. Saw Mr. Brown. Said I could not get results of test until Monday. Took one of the samples to biochemical laboratory and got results at 3. Streptococci. Closed down the dairy, came back and took samples of all the cows and checked all up. At 9 P.M. we had the 3 infected ones found; also found that there were 59 cases in town. The State Inspectors were here the next day, at 2 P.M., and looked over the ground, and Dr. Linenthall sent the Board a letter telling them what was necessary before he could open again, etc. There were 126 cases all told of this sore throat. No milk has ever been sold by this man since, and he went out of business. It was the best thing that ever happened, as it was a lever for me to bring every one to their senses as to the conditions. We did have 35 cows all told in town, from 2 to 14 in herds; to-day we have none.

Appendix J.

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Appendix K.

LIST OF CONFERENCES AND MEETINGS ATTENDED OR OF PERSONS INTERVIEWED RELATIVE TO THE MILK QUESTION.

Massachusetts State Grange Executive Committee Meetings.
New England Holstein-Friesian Cattle Breeders' Association Meeting.
Massachusetts Milk Inspectors Association Meeting.
Legislative Hearings.
Meeting at Century Club (Dr. North's Lecture).
Field Meetings of Massachusetts State Grange (25), and interviews with many persons at these meetings.
Dairymen interviewed in Massachusetts, Vermont, New Hampshire and Province of Quebec while on inspection trips (probably 150 to 200).
Hon. Wilfrid Wheeler, Secretary, State Board of Agriculture.
Dr. L. O. Howard, Commissioner, Massachusetts Department of Animal Industry.
P. M. Harwood, Agent, State Dairy Bureau.
Hon. Chas. M. Gardner, Past Master, Massachusetts State Grange, Chairman, State Dairy Bureau.
Mr. Tinkham of the Rhode Island Inquiry Board.
Dr. Stone, Massachusetts State Board of Insanity.
Dr. Frank Woods (Holyoke) on value of fresh milk for babies.
Dr. Mark W. Richardson on value of fresh milk for babies.
Members of the Massachusetts State Board of Agriculture.
J. L. Ellsworth, Past Secretary, Massachusetts State Board of Agriculture.
Mr. Sacker, President, New England Cattle Dealers' Association.
Various dealers in milch cows at Brighton.
Dr. Davis (Hood & Co., Charlestown plant).
Mr. Park (Hood & Co., Lynn plant).
Mr. Whiting (Whiting's plant in Charlestown).
Mr. Blossom (Hood Agent, North Hatley, Que.).
Mr. Lamson (United States Dept. of Agriculture, Bureau of Chemistry, North Hatley, Que.).
Mr. Myron T. Pierce (Attorney, Milk Consumers' League).
Mr. J. C. Orcutt (Assistant Secretary, Boston Chamber of Commerce).
Westport, Maine, Agricultural Fair.
Segreganset Agricultural School.
Essex County Agricultural School.

Mr. Lombard, Inspector, Massachusetts State Board of Agriculture Dairy Bureau.
Mr. J. F. Bresnahan, Milk Inspector, Fitchburg.
Mr. G. A. Flanagan, Milk Inspector, Lynn.
Dr. Stanbridge, Milk Inspector, Winchendon.
Dr. P. H. Mullowney, Department Commissioner, Boston Health Department.
Dr. Thos. E. Maloney, Board of Health, Fall River.
Mr. W. E. Ward, Milk Inspector, Brookline.
Mr. A. W. Russell, Agent, Board of Health, Newton.
Mr. Geo. Barrow, Milk dealer, Waltham.
Mr. Childs, Milk dealer, Waltham.
Dr. H. W. Pierce, Massachusetts State Department of Animal Industry.
Dr. Milliken, Chairman, Barnstable Board of Health.
Mr. Mecarta, Milk Inspector, Barnstable Board of Health.
Mr. John Cook, Chairman, Provincetown Board of Health.
Mr. G. L. Berg, Milk Inspector, Worcester.
Mr. H. E. Bowman, Milk Inspector, Somerville.
Dr. F. G. Curtis, Chairman, Newton Board of Health.
Various officials of the New York City Health Department, including the Commissioner of Health, the Chief of the Division of Foods, the Chief of the Division of Milk Inspection, the Chief and the Epidemiologist of the Bureau of Infectious Diseases.
Convention of Certified Milk Producers' Association at Atlantic City, N. J.
Convention of International Milk Inspectors' Association at Washington.
Convention of Official Agricultural Chemists, Washington.
Convention of the American Public Health Association, Rochester, N. Y.
Plant of the George M. Oyster Milk Company, Washington, D. C.
Plant of the Borden Condensed Milk Company, New York City.
Plant of Slawson Decker-Sheffield Farms Company, New York City.
Plants of H. P. Hood & Sons at Boston and Lynn, Mass., Newport, Vt., and Unity, Me.
Plants of D. Whiting & Sons, Boston, Mass., Thorndike, Newbury, Ætna and Pittsfield, Me.
Plants of C. Brigham Company, Cambridge.
Plants of the Turner Centre Dairying Association at Auburn, Benton, Wiscasset and Unity, Me.
Dr. Fred Meader, Chief of Division of Communicable Diseases of the New York State Health Department at Albany.
Dr. Herman Biggs, New York State Commissioner of Health, New York City.
Dr. A. J. Chesley, Chief, Division of Preventable Diseases, Minnesota Board of Health, at Rochester.
Assistant Surgeon General J. W. Trask, United States Public Health Service, at Rochester.

Hon. W. T. Guptill, State Commissioner of Agriculture, A. M. G. Soule, Chief of Bureau of Inspection, and Mr. J. H. Blanchard, State Dairy Instructor, all of the Department of Agriculture of Maine.

Dr. Ivan C. Weld, Secretary, International Milk Inspectors' Association.

Mr. Julius Hortvet, State Chemist, Minnesota, and member of the Joint Committee on Standards, United States Department of Agriculture.

Mr. Jones, Associate Chief, Bureau of Chemistry, United States Department of Agriculture.

Hon. F. A. Stadtmueller, Dairy and Food Commissioner of Connecticut.

Dr. Charles V. Chapin, Superintendent of Health, Providence, R. I.

E. L. Bradford, Manager, Turner Centre Dairying Association, and many others.

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